LVII No. 3 SEPTEMBER 1958 50 CENTS

UNIVERSITY OF MICHIGAN
SEP 22 1958
PERIODICAL READING ROOM

CANADIAN GEOGRAPHICAL JOURNAL

Between Yellowknife and Great Bear — A. Y. JACKSON, C.M.G., LL.D.

Northern Issue

Published by THE ROYAL CANADIAN GEOGRAPHICAL SOCIETY

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OTTAWA, CANADA

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CANADIAN GEOGRAPHICAL JOURNAL

Published monthly by

THE ROYAL CANADIAN GEOGRAPHICAL SOCIETY

Ottawa, Ontario

Editor - GORDON M. DALLYN

This magazine is dedicated to the presentation in authentic and popular form, with extensive illustrations, of the broad pattern of Canadian life and its industrial, physical, and cultural foundations.

The articles in this Journal are indexed in the *International Index to Periodicals* and in the *Canadian Index*.

The British standard of spelling is adopted substantially as used by the Government of Canada and taught in most Canadian schools, the precise authority being the Concise Oxford Dictionary, fourth edition, 1951.

Address all communications regarding change of address, non-delivery of Journal, etc., to the publication office, 1000 St. Antoine St., Montreal 3, Canada, giving old and new address. On all memberships, the expiry date will be printed on wrapper. This will constitute a receipt for subscription.

Membership dues of The Royal Canadian Geographical Society, which include postpaid delivery of the Journal, are $5.00 per year in any country, payable at par in Ottawa. All remittances should be sent to Head Office.

Member Audit Bureau of Circulations

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SPECIAL REPRESENTATIVES:
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SEPTEMBER 1958 ✦ VOLUME LVII ✦ NUMBER 3

COVER SUBJECT:—*"Between Yellowknife and Great Bear" from the painting by A. Y. Jackson. Plates courtesy of the National Gallery of Canada.*

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AUTHORIZED AS SECOND CLASS MAIL, POST OFFICE DEPARTMENT, OTTAWA
PRINTED IN CANADA

The north as the layman commonly pictures it — a frozen land where polar bears roam. This photograph was taken on Ellesmere Island, Canada's most northerly island. N.F.B.

The Face of the North

by N. L. NICHOLSON

THE TERM "the Canadian North" has a different meaning for different people and in no interpretation of the term are there more divergent views than with regard to the area to which it refers. To a non-Canadian it may be all of Canada. To most Ontarians it may be the gold mining district of Timmins or the James Bay port of Moosonee. Yet both Timmins and Moosonee are in more southerly latitudes than Edmonton which to Albertans, at least, is merely the southern gateway to "the North". A simple definition is elusive. Perhaps the best that we can say is that the north is far enough away from "civilization" to be considered "remote". One thing is certain, however. Its southern boundary is not a single line of latitude. It more nearly approximates to the northern limit of Canadian commercial agriculture. This is essentially a climatic boundary — the southern limit of the sub-arctic climate. Within this sub-arctic region there are less than four months with an average temperature of more than 50° Fahrenheit, while the average January temperature is below 26° Fahrenheit, and may be as low as 36° Fahrenheit below zero. Thus the sub-arctic is a region of short, cool summers and long, usually severe winters. This straddles fifty-three per cent of Canada in a broad arc from the Alaskan border to the Atlantic coast of Newfoundland. But north of the sub-arctic and in patches in the mountains of British Columbia lies the arctic — an area covering almost one-quarter of Canada in which the mean temperature of the warmest month, although above freezing, is never above 50° Fahrenheit. But these simple definitions based on average temperatures give no idea of the climatic paradoxes which can occur in the North. Cool and short though the summers are, temperatures of over 100° Fahrenheit have been recorded in the area about Fort Smith. This is in contrast to the lowest recorded temperature of 83° Fahrenheit below zero at Snag in the Yukon. Similarly, the precipitation of over eighty inches a year in northwest British Columbia contrasts with the average annual precipitation of only 2.59 inches at Eureka on Ellesmere Island — the lowest

average annual precipitation figure for any place in Canada. Generally the snowfall of the north is light — less than half the amount which falls in Montreal, and yet parts of the Labrador coast receive twice as much as that city. Also, three per cent of Canada is covered with permanent ice and snow and all but a small amount of it in the southern mountains of British Columbia is in the North. In these areas of "ice-cap" climate the average monthly temperatures are always below 32° Fahrenheit.

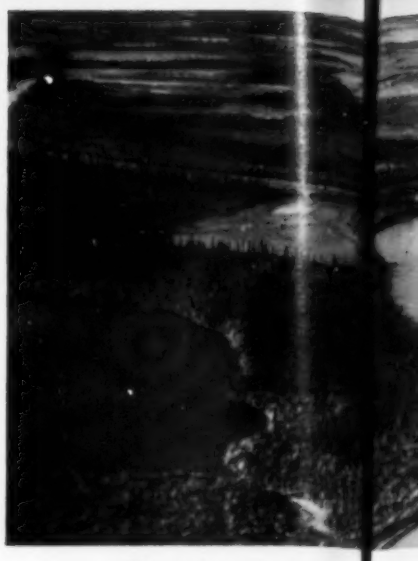
Climatically then, there are three "Norths" — the permanent ice and snow fields, the arctic and the sub-arctic. But within the seventy-eight per cent of Canada's area which they embrace, the further variations are added as a result of the topography, for the western and eastern approaches to the North are guarded by mountains. In the west they include the highest peak in Canada — Mount Logan, 19,850 feet high; while in the east, though the mountain rim is less than 300 feet above sea-level on the island of Newfoundland, it exceeds 5,000 feet in the Torngat Mountains and 10,000 feet in northern Ellesmere Island. From these highland rims the land for the most part slopes to the myriad channels which break the "Far North" into a multitude of islands. A score of these are larger than Prince Edward Island, while Baffin Island is almost as large as France, and Ellesmere and Victoria Islands are each larger than England and Scotland combined. Farther south the land drains to Hudson Bay and Foxe Basin. Locally the shores terminate abruptly, as along the west coast of Baffin Island or the west coast of Quebec. In other places they slope imperceptibly beneath the salt water, as is the case with the broad, poorly drained lowlands which flank the Manitoba and Ontario shores of Hudson Bay. Indeed, in Foxe Basin, Prince Charles Island is so indistinguishable from the waters around it that it remained undiscovered until aerial photographs disclosed its existence as recently as 1946.

But the descent from the mountains to the northern seas and straits is no gradual one. Surrounding Hudson Bay and Strait is the Canadian Shield — an immense stable block of ancient rocks, mostly granitic. Lacking hills of any size except along its mountainlike eastern rim, the Shield, when seen from the air, presents a monotonous landscape. Yet it is not without its variety, most of which has been produced by the geologically recent glaciations. In places, the glaciers roughened the surface into a "rock-knob" type of landscape and the hollows between the "knobs" are now occupied by enormous numbers of lakes of all shapes and sizes. Elsewhere, as in the Labrador Trough, the landscape consists of a series of long, parallel ridges and valleys — all that remains after the work of the forces of erosion in areas of ancient folding. In places these valleys have become filled with water, producing striking finger-like islands such as the Belcher Islands of Hudson Bay or lakes like Lake Mistassini. In other places, the glaciers deposited morainal material on the surface — boulders, sand, silts and clay, in the form of sheets, or in isolated heaps and locally in the form of eskers, which look like railway embankments running across the country for 100 miles or so, and which mark the course of streams which once flowed beneath the ice. The western edge of the Shield is characterized by several large lakes. Lake Winnipeg, Great Slave Lake and Great Bear Lake are each about half the size of Nova Scotia.

Between the Shield and the western mountains lies part of the interior plains of North America, which in their entirety extend from the Gulf of Mexico to the Arctic Ocean. Dominating the northern part of these plains are the Mackenzie River and the lower portions of its tributaries. In contrast to the rivers of the Shield, which are characteristically interrupted by rapids and falls, the Mackenzie system is one of the most magnificent navigable waterways in the world. The only break in navigation in the 1,700-mile stretch from the end of the railway at Waterways, Alberta, to the Beaufort Sea is the sixteen miles of rapids in the Slave River south of Fort Smith. Impressive to the end, the Mackenzie River reaches the sea through the maze of channels in the delta which it has spread over several hundreds of square miles.

The contrast between this landscape and that of the western mountains could hardly be more striking, for west of the interior plains the Rocky Mountains and its northern extensions

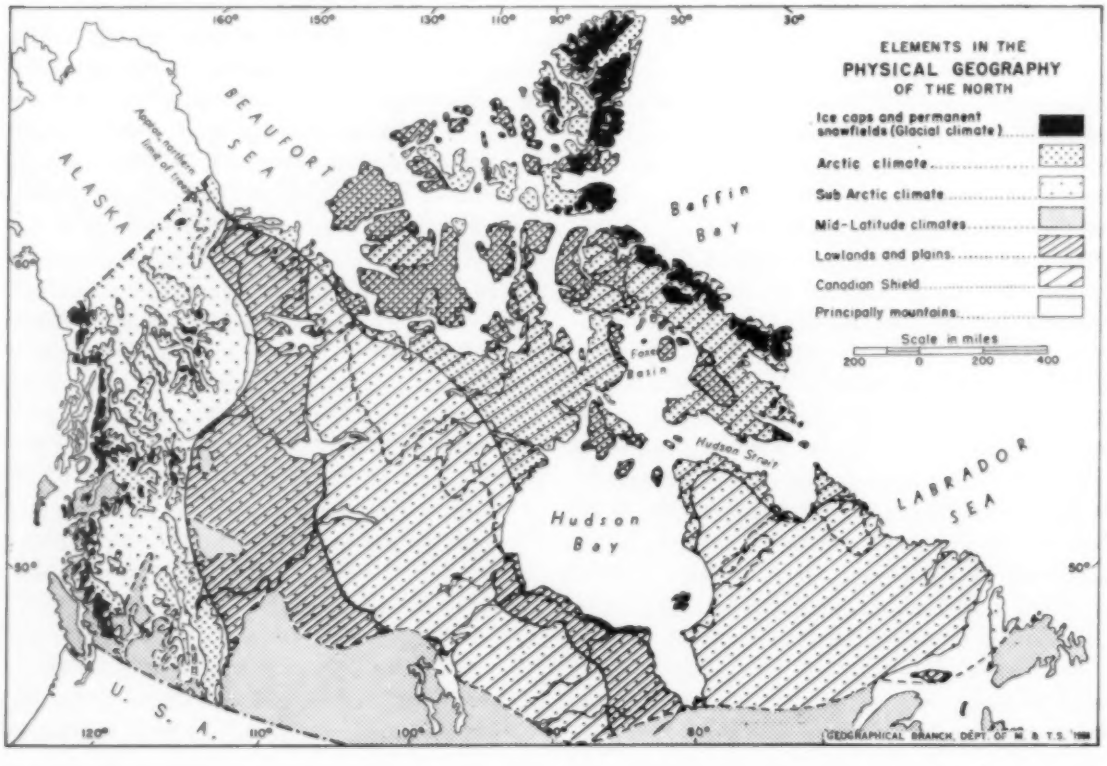
The traditional north — an Eskimo woman with drying fish at Spence Bay, central Northwest Territories.



The wet north — part of [illegible], Nor

— the Mackenzie, Richardson and British Mountains — rise abruptly to heights up to over 10,000 feet. These, in turn, give way to the series of lower mountains, high dissected uplands and narrow valleys of the interior of the Yukon and British Columbia, only to be succeeded by the even greater heights of the Coast Mountains and the St. Elias Mountains before the Pacific Ocean is reached.

Nature has clothed these varying topographic forms in a variety of ways. Essentially, the arctic is non-forested and to its variety of low-growing plants the name tundra has been applied. The sub-arctic, on the other hand, is a forested zone generally referred to as taiga or the northern coniferous forest, or simply as the boreal (northern) forest. While it consists essentially of coniferous trees characterized by white and black spruces and tamarack with a sprinkling of such deciduous trees



part of ..., Northwest Territories.

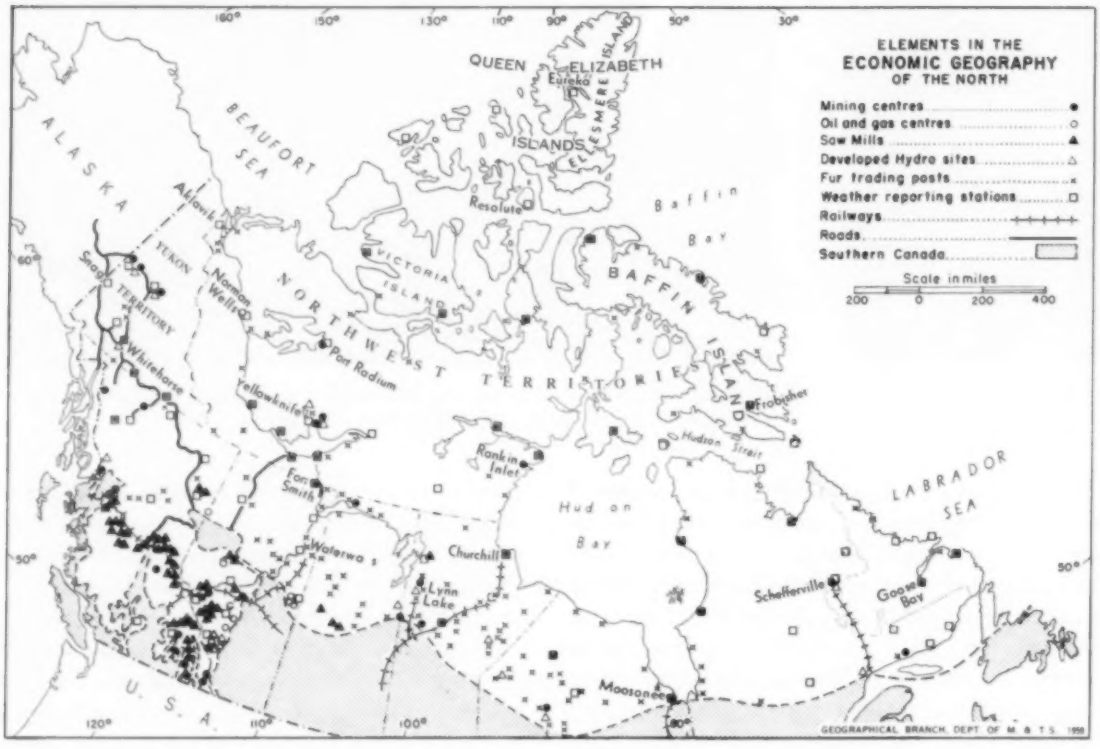
The mountainous north — Mount Lloyd George, 10,000 feet above sea-level in northern British Columbia.

as white birch and poplar, it varies considerably in composition and density from place to place. Balsam fir and jack pine are predominant in the eastern and central portions, and Alpine fir and lodge-pole pine in the western and northwestern parts, particularly on the slopes of the mountains. In the southeastern parts there is a considerable intrusion of such species as the red and the white pines, yellow birch and sugar maple. Then in the northern parts the proportion of rock, muskeg and tundra gradually increases, for there is commonly no sharp break between the taiga and the tundra.

Similarly, within the tundra itself the nature and amount of vegetation varies with soil, water conditions and exposure to wind. Mosses and sedges are common, intermixed with streams, lakes, peat bogs and swamps, the latter often resulting from poor drainage because of the underlying permafrost (permanently frozen ground). But small willows, a foot or two in height, and bushes are common around the wet edges of the marshes or in the more favourably sheltered places. Sandy areas or rocky lower slopes are often covered with heaths of lichens and grasses. Many areas that are simply bare bedrock or disintegrated frost-shattered rock and glacial boulders have no vegetative cover. This is typical of the mountainous areas and the tops of rocky ridges.

The flora of the North has an economic significance in that it is important to the wildlife within the region whose numbers and distribution can be traced directly to the distribution of the plant life. Consequently, the wildlife can be primarily divided into that which dwells in the taiga and that of the tundra. One of the most remarkable animals is the musk-ox which, with Peary's caribou, finds its food in the arctic pastures of the Queen Elizabeth Islands of the Far North. Farther south the principal grazing animal is the Barren Ground caribou, which also spreads southward into the northern parts of the forested zone where, in the west, the mountain caribou is also found. The carnivorous animals of the tundra include the polar bear, the arctic wolf and the arctic fox and among the smaller animals are the arctic hare, lemmings, squirrels and mice. In an area in such intimate contact with the sea, sea-life, too, is important. Various species of whales and seals and the Atlantic walrus are all found. And of the sea fish, the arctic char is the one most used for food. In addition, the fresh-water lakes support white-fish, lake trout and pike. Insect life is also abundant and birds like the ptarmigan make the tundra their permanent home. Others, like the whistling swan and several species of geese, choose to summer in the region. The boreal forest similarly supports a varied wildlife typified by the moose, which browse among the shrubs and low-growing trees, the woodland caribou and the fur-bearing rodents — the beaver and muskrat. The larger carnivorous animals include the black bear and, in the west, the grizzly bear, the coyote, timber wolf and red fox. The smaller ones include the otter, marten, wolverine and mink.

And what of man ? To what extent has he added further variety to the fabric of which the North is woven ? By definition, his civilization has not penetrated to any great extent and



signs of his activities are like fly-specks on the map of Canada. In 1956, the Northwest Territories had a population of just over 19,000 and the Yukon Territory just over 12,000. Thus, excluding the northern parts of the provinces, the North has a total population of some 31,000 or almost the same as the population of cities like Sydney, Nova Scotia, or Kingston, Ontario. Commercial agriculture is so limited as to be virtually non-existent. However, in the Yukon there are some small farms as far north as Dawson but at the most such cultivated land does not exceed two square miles — out of a total of 207,000 square miles. Corn has been ripened on the banks of the Mackenzie at Norman Wells; potatoes have been grown at Fort Simpson for shipment farther North; cabbages the size of footballs can be grown at places like Aklavik and tomatoes at Coppermine, in soil carefully gathered in buckets. But can these activities be developed and expanded ? At the moment the main commercial activities still depend on furs, minerals and the forest. It was the search for furs that led to the first settlements in the North and the fur-trading posts of the Hudson's Bay Company still form the nucleus of scores of northern hamlets. But today, the number of fur-bearing animals is decreasing and the fluctuating prices for pelts make the industry a precarious one. Minerals, too, were an early lure to the North, from the days when Martin Frobisher sought gold on Baffin Island in the sixteenth century. Three decades later, the gold rush to the Stickeen country established the northern boundaries of British Columbia and the gold rush to the Klondike established

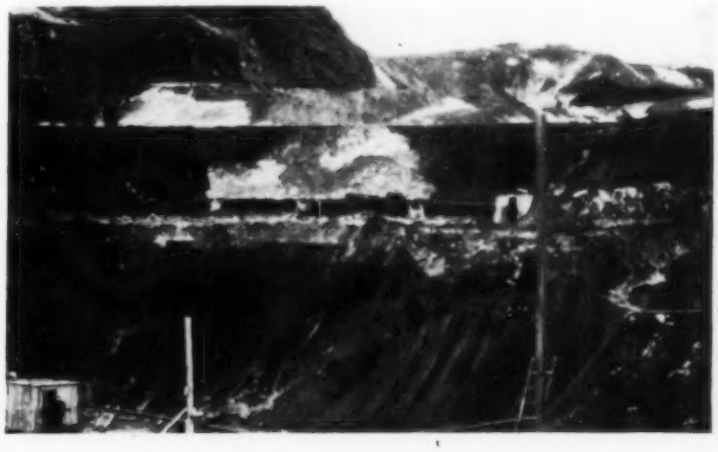
The new north — the oil refining and communications centre of Norman Wells, Northwest Territories. Waste natural gas is burning in the foreground.

the Yukon Territory. Gold mining is still a major activity. Indeed, Yellowknife, with a population of 3,100 and the largest settlement in the Northwest Territories, is founded on it. Gold also led to the construction of Canada's northernmost railway — the White Pass and Yukon Route from the Pacific Ocean to Whitehorse. Eventually other minerals were discovered — oil at Norman Wells and later, with gas, in the Peace River country; uranium at Port Radium and, later, on the shores of Lake Athabasca in Northern Saskatchewan; nickel and copper at Lynn Lake in Northern Manitoba; iron at Schefferville; asbestos at Cassiar, just south of the Yukon border; and nickel at Rankin Inlet, 300 miles north of Churchill. A complete recital would take pages. It is to be expected that even more mineral wealth will be discovered as surveys and exploration proceed. But the development of many of the deposits will be dependent on adequate transportation facilities for moving ores to the south and perhaps overseas. More railways will be needed to extend the northward-creeping tentacles of steel which have already reached Schefferville and Lynn Lake and more roads to supplement the ribbons of gravel which now lead to Great Slave Lake and Alaska. But mining development, sawmills and modern communities also require power. Here the North has undeveloped potential, particularly where the rivers spill over, or can be made to spill over, the rugged topography in the east and the west and where the chaotic drainage of the Canadian Shield has produced rapids and waterfalls. To create Kitimat, the Nechako River was dammed and made to run backwards through a mountain to drop sixteen times the height of Niagara and so generate power to refine alumina and create a community of 15,000 people.

One of the other "resources" of the North is its location with respect to Western Europe. The fact that the Hudson Bay route is almost as short a sea-route to Liverpool as that from Montreal was of prime importance in the construction of Canada's first northern port at Churchill and its railway to the south. But it was not until the air age arrived that man took a further look at the globe and realized that the shortest distances between the main land masses of the Northern Hemisphere were not those which followed lines of latitude across the Atlantic or Pacific but those which followed great circle routes across Northern Canada. Today, several scheduled airlines cross the North, so that tiny settlements like Frobisher with 2,500 take-offs a month have become busy airports and may be destined to become large cities in the future. With the air age, too, came the need for observational data on the weather in the North. Because of this, the most northerly settlements in Canada were established in the Queen Elizabeth Islands. But if the locational advantages of the Canadian North have led to the developments in civil aviation, they have also created an awareness that attacks by high-powered aircraft could come from this direction in time of war. The reaction has been to construct radar warning systems across the North — the Mid Canada Line and the Distant Early Warning (DEW) Line. It is to be hoped that these will never be needed, but in the meantime their construction has aided northern development and their continual maintenance may stimulate other activities which will change the face of the North still more.

A northern road — the Alaska Highway near Teslin, Yukon Territory.

Northern mining — an iron ore mine at Schefferville in northern Quebec.



The Romance of Northern Exploration

by F. J. ALCOCK

THE STORY of exploration in northern Canada is a saga that can perhaps be best summarized under certain names that have a secure place in Canadian history. Some of these were seamen who were the first to thrust their ships into unknown waters; others were land travellers journeying occasionally on foot, sometimes by dog-team, but more often along inland waterways by canoe or boat, crossing vast new areas and undergoing at times extremes of privation and hardship. The story which has been preserved, of which only a few highlights can be presented here, is found in the personal journals of many of the explorers themselves, in numerous official reports, and in a wealth of summaries and commentaries.

The impetus for this exploration stemmed from three main sources which, while at times overlapping, were for the most part distinct from one another. There was first of all the desire to find a northern route from Europe to the Orient — the long-elusive Northwest Passage. There was secondly the wealth in furs whose exploitation by rival traders from Hudson Bay and Montreal led to a vast amount of inland exploration. Coupled with this was the desire to find an overland route to the Western Sea, partly in order to secure a shorter way of supplying the far western trading posts. Finally, following Confederation in 1867, the addition to Canada of the broad regions to the west and north of the two original provinces of Lower and Upper Canada led to exploration by Dominion Government officers, chiefly those of the Geological Survey of Canada. It became their task to map the newly added territory and report on its rocks, minerals, soils, forests, water-power, fauna, flora, and native inhabitants. This tremendous task is still being actively pursued. During the past quarter of a century its tempo has been greatly increased due to air transportation, the photographing of the country from the air, and the preparation of base maps from such photographs.

Historical Summary

Following the discovery of America by Columbus in 1492, John Cabot five years later made the first British-sponsored voyage to the New World. In the following year he sailed again, landed on the east coast of Greenland and then turning south touched Baffin Land

At top:—
A Montreal canoe is paddled past rocky cliffs. From the original painting by Mrs. Frances Hopkins in the Public Archives of Canada. Public Archives of Canada

and continued on to New England waters. In 1508-9 his son Sebastian visited the coast of Labrador in a vain quest for a route to Asia. In 1534 the St. Malo sea-captain, Jacques Cartier, instructed to seek a northwest passage to the Spice Islands, explored the Gulf of St. Lawrence, erecting at Gaspe Basin a cross bearing the arms of France, signifying that he took possession of the country for his master, François I. In the following year he again crossed to Canada, ascending the St. Lawrence River to Quebec and Montreal. French settlement began under Samuel de Champlain, first in what is now Nova Scotia and later in 1608 at Quebec. Even earlier Sir Humphrey Gilbert, under a patent of Queen Elizabeth I, took possession of the harbour of St. John's, Newfoundland, in 1583, and founded there the first English colony in North America, which eventually in 1949 became part of Canada.

With settlements established in New France at Quebec and Montreal, trade in furs became the profitable industry and to develop it exploration proceeded to the north and west. This culminated in the period 1732 to 1743 with Pierre Gaultier de Varennes, Sieur de La Vérendrye and his sons finding their way from Lake of the Woods to Lake Winnipeg and the Red and Assiniboine Rivers and finally overland to the eastern slope of the Rocky Mountains.

In the meantime, the English became established on Hudson Bay. In 1670 a charter was granted by King Charles II to "The Governor and Company of Adventurers of England Trading into Hudson's Bay", granting them the monopoly of the trade, fisheries, minerals, and so on, of all the lands bordering on that great inland sea. Trading posts were established at the mouths of rivers, first on the coast of James Bay and later on the coast of Hudson Bay proper, and the natives were induced to bring their furs to them. As long as this continued, the company made little effort to explore inland.

The transfer of Canada to the British in 1763 brought a considerable number of merchants, many of them Scots, to Montreal. They became interested in the fur trade and soon their *voyageurs* had rediscovered the old French canoe routes to the northwest and trading posts began to be established far inland. The resultant falling off of the flow of furs to Hudson Bay aroused the English company to the fact that if they were to retain their trade they would have to follow their rivals' example — something which, beginning with the founding of Cumberland House on the Saskatchewan in 1774, they hastened to do.

In 1784 the Montreal traders organized into a strong company called the North West Company, which intensified the rivalry. Fort William on Lake Superior became their main central emporium; to it every spring came great canoe brigades from Montreal laden with supplies and trading goods and from it other brigades of smaller canoes supplied the subsidiary posts to the far west. York Factory at the mouth of the Hayes River on Hudson Bay long remained the distributing depot of the Hudson's Bay Company and from it brigades of what were known as York boats supplied their inland posts. A new phase of the rivalry developed when Lord Selkirk of the Hudson's Bay Company sent out a contingent of settlers from Scotland. The first band arrived at the Red River in 1812 and a second three years

Martin Frobisher made three voyages (1576-8) to the New World in search of the Northwest Passage.
Geological Survey of Canada

A York boat on Cross Lake in northern Manitoba in 1913.
Hudson's Bay Company

later. The climax was reached on 19 June 1816, when Governor Robert Semple of the colony and twenty of his men were killed at Seven Oaks by North Westers. The final result was the union of the two companies in 1821 under the name of the Hudson's Bay Company. After the union operations were extended far north and into the Yukon.

Hudson Bay

Though Martin Frobisher in his three voyages in search of a Northwest Passage, 1576-8, explored the bay on Baffin Island which bears his name, and John Davis in 1585 discovered the strait called after him, it remained for Henry Hudson, who in 1609 had explored the Hudson River in New England, to first penetrate in the following year through Hudson Strait into the great bay also named after him. He followed its east coast and wintered in the southeast corner of James Bay. In the spring of 1611, with provisions almost exhausted, his crew mutinied. Hudson with his son, aged seven, and seven invalid members of the expedition were cast adrift in an an open boat and were never heard of again. Some of the mutineers perished on the way home to England. The survivors on their arrival were brought to trial and strangely enough were acquitted.

In 1612 Sir Thomas Button was sent out by the Company of the Merchants of London Discoverers of the North-west Passage. He wintered at Port Nelson on the western coast and explored part of it. In 1615 Robert Bylot and William Baffin examined the western side of the bay and announced that no northwest passage was to be found by way of it. In 1619 Jens Munck, a Scandinavian sea-captain, discovered Churchill harbour and wintered there with his two ships. By spring only he himself and three others survived out of a combined crew of sixty-four. With great difficulty they succeeded in reaching Denmark in the smaller vessel. In 1631 Luke Fox of Hull and Thomas James of Bristol carried out further explorations on this same coast. Probably, however, the most eventful of the early voyages into the bay was that of Médard Chouart, Sieur des Groseilliers, in the *Nonsuch*, financed by a group of English adventurers. Sailing in 1668, Groseilliers built Fort Charles at the mouth of the Rupert River and in the following spring sailed for England with a very valuable cargo of furs. As already mentioned, the result was the granting of a charter to what became known as the Hudson's Bay Company, giving it the monopoly of the fur trade and other resources of the whole Hudson Bay region.

Samuel Hearne

In the period 1733 to 1771 the Hudson's Bay Company built at the mouth of the Churchill River a great stone fort named Fort Prince of Wales. To it Indians brought pieces of native copper said to come from a river far to the

northwest. In 1769 Governor Norton decided to send an expedition to investigate these reports and the one chosen to lead it was a young man named Samuel Hearne. In November Hearne set out accompanied by two English volunteers and a body of Indians. Two hundred miles from the fort the Indians deserted and Hearne was left to find his own way back. In February, however, he set out again with a smaller party of five Indians. Again he was at the mercy of his guides, who showed little enthusiasm for the long trip to the Coppermine. Finally he had the misfortune to break his quadrant and accordingly found it necessary to return again to Fort Prince of Wales, which he reached on 25 November after an absence of over eight months.

On his return journey Hearne fell in with an Indian chief named Matonabbee, who volunteered to guide him to the Coppermine if he desired to make a third attempt, an offer which Hearne gladly accepted. Starting in December 1770, they travelled with dogs and sleds along the edge of the tundra. In the spring they turned north toward the Coppermine and on 13 July reached that stream, which Hearne followed to the Arctic Ocean. On his return journey he discovered Great Slave Lake and finally reached Fort Prince of Wales in June 1772 after an absence this time of eighteen months and twenty-three days. He had found but little copper. His explorations had shown, however, that there was no channel through the continent in any of the latitudes of Hudson Bay.

Alexander Mackenzie

The first white man to find his way from the Saskatchewan River over the Methye Portage divide to the Athabasca waters was a trader by the name of Peter Pond. He built a post on that river about thirty miles above where it enters Lake Athabasca and explored much of the surrounding region. A greater explorer than he, however, was to find out where the Athabasca waters eventually reach the sea. This was Alexander Mackenzie, the first one to follow to its mouth the great river which bears his name and later the first white man to reach the Pacific Ocean by an overland route north of Mexico.

Mackenzie, born in Scotland in 1764, came to Canada with his father at the age of ten and five years later entered the fur trade. Sent to the Athabasca region, he started out on 3 June 1789 from Fort Chipewyan at the western end of Lake Athabasca in a canoe manned by four French-Canadian canoemen, two of whom were accompanied by their wives, and a young German; an Indian with two of his wives occupied a small canoe and two other Indians another. Descending Slave River, they reached Great Slave Lake, where they were delayed by ice and by a search for the outlet, which was located on 29 June. It was now a race against time, if they were to reach the mouth of the river and return the same season. Starting at four, three and sometimes two o'clock in the morning, Mackenzie urged his men forward. With provisions running short, his Indians urged him to return. Finally he promised that if in seven more days they did not reach the sea they would turn back. On 14 July they reached Arctic waters and saw white whales at play. The great river had been followed to its mouth. The return journey was safely made and Fort Chipewyan was reached on 12 September after an absence of 102 days and the

Samuel Hearne — one of the great eighteenth century explorers of the Canadian North.
National Museum of Canada

Alexander Mackenzie traced the Mackenzie River to its mouth and was the first European explorer to reach Canada's Pacific coast by an overland route. From the painting by Sir T. Lawrence.
Geological Survey of Canada

completion of one of the most noteworthy exploits in the history of inland exploration.

On 9 May 1793, Mackenzie set out on his second great adventure, this time to cross the mountains to the western sea. He took with him Alexander Mackay, who was also a North Wester, six French-Canadians and two Indians. Their route led up the Peace River and the Parsnip, across a divide to waters flowing into the Fraser, overland again to the Bella Coola and down that stream to the Pacific, which he reached on 20 July. It was a momentous journey with many major difficulties in the form of long rapids, cascades and canyons, hostile natives and lack of competent guides. The return journey was almost as difficult, but this time they knew their route and on 24 August they were back at their starting point.

Turnor and Fidler

Two important names in connection with inland surveys carried out by the Hudson's Bay Company are those of Philip Turnor and Peter Fidler. The former in the period of 1790 to 1792, starting at York Factory, surveyed the Saskatchewan River to the forks, the Sturgeon-weir and the upper Churchill to Methye Portage and on by way of the Clearwater and Athabasca Rivers to Great Slave Lake. He made a careful map of Lake Athabasca. In his explorations he was accompanied by Peter Fidler, who later carried out extensive surveys of his own.

David Thompson

The greatest of the trading companies' surveyors and map-makers was, however, David Thompson. Born in 1770, he entered the service of the Hudson's Bay Company in 1784 but in 1797 left that company to join its great rival, the North West Company. He was one of the world's greatest geographers. Both the extent of his explorations and the accuracy of his work have won the admiration of all who later followed the routes he explored. His surveys included the St. Lawrence and Lake Superior regions, the plains and rivers to the west and particularly routes through the mountains to the upper Columbia waters.

Athabasca River scow at the Big Cascade above McMurray.
Hudson's Bay Company

Sir John Franklin whose disappearance in Arctic waters in 1845 led to extensive exploration by parties sent to search for him.
Public Archives of Canada

Franklin, Richardson, Back

In 1819 a British expedition under the command of Captain Franklin (later Admiral Sir John Franklin) was sent to explore and obtain scientific information about Arctic Canada. Accompanied by Dr. John Richardson and two midshipmen, George Back and Robert Hood, Franklin proceeded from York Factory to Fort Chipewyan and on to Fort Providence on Great Slave Lake. From here they followed a new route by way of Yellowknife River to the Coppermine. Descending the latter to its mouth, they proceeded eastward along the bleak Arctic coast. The return journey was marked by almost complete exhaustion and near starvation. Eventually in 1822 they returned, having completed a circuit of 5,550 miles. Three years later Franklin made a second journey, this time down the Mackenzie River and along the Arctic coast, Franklin and Back exploring to the west and Richardson to the east as far as the mouth of the Coppermine. This expedition resulted in a great deal of new information gained with much less hardship than had been encountered on their former expedition.

In 1833 Back, now Captain, later Admiral Sir George, returned to Arctic Canada to search for information about the fate of an expedition that had sailed in 1829 under Captain John Ross. On learning that Ross was safe, Back was free to carry out exploration and he surveyed for a distance of 530 miles to its mouth the Great Fish River, now known as Back River. Later Thomas Simpson of the Hudson's Bay Company carried out further exploration in this field.

In 1845 Sir John Franklin set out on a third expedition, this time by sea in command of two ships, the *Erebus* and *Terror*, to search for a northwest passage. He was last seen in Lancaster Sound on 26 July 1845. When he failed to return, some forty expeditions altogether were sent out in search of him over a period of years. These indirectly resulted in the accumulation of much further geographical information. The names of Dr. John Rae, Sir John Richardson, Franklin's former companion in discovery, and James Anderson are particularly important in this connection. Rae found that part of the expedition had perished on King William Island, and in 1859 Captain F. Leopold M'Clintock of the yacht *Fox* secured proof of the death of Franklin and his crew, proof abundantly confirmed by later explorers.

George Back accompanied Franklin on his first two expeditions into the Arctic. He later surveyed the Great Fish River (now the Back River) to its mouth.
Public Archives of Canada

The Geological Survey

As has been mentioned, northern exploration since Confederation has to a considerable ex-

tent been the responsibility of the Geological Survey of Canada. When the second director, Dr. A. R. C. Selwyn, took over from his predecessor, Sir William Logan, the leadership of this organization, the task confronting him was a gigantic one. Certain streams and travel routes had been mapped, but many others remained unknown and between were huge blanks on the map concerning which there was no information whatever. It was a challenge to which Selwyn and his staff enthusiastically rose. The work of Selwyn himself in the interior of British Columbia, of George M. Dawson and R. G. McConnell in that province and in the Yukon, of J. B. Tyrrell in the region west of Hudson Bay, of A. P. Low in Labrador Peninsula, of Robert Bell, D. B. Dowling, William McInnes, Joseph Keele, Charles Camsell, and others in various parts of northern Canada are but some of the Survey's accomplishments in this connection.

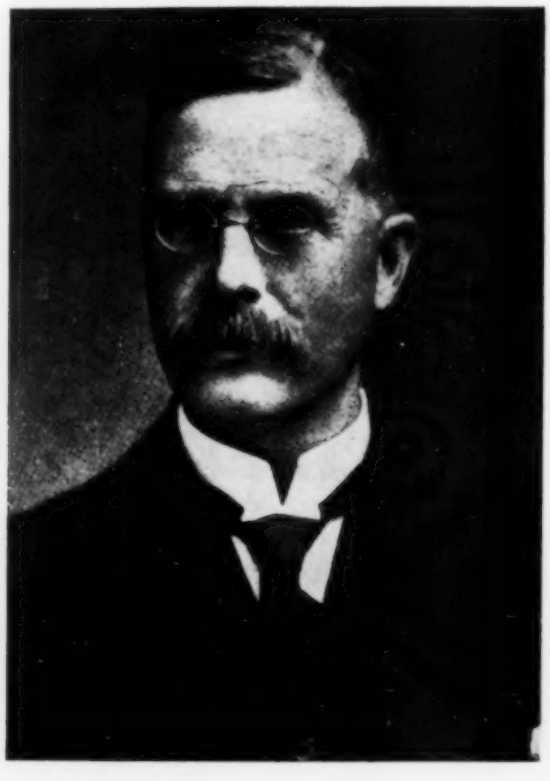
Reference can be made to only two of these. In 1892, under instructions from Selwyn, Joseph Burr Tyrrell explored a large area north of the Churchill River. Hearing of a great northward flowing river which apparently traversed a belt of some 200,000 square miles concerning which the only information was the meagre account of Samuel Hearne, who had crossed it on foot over a century previously, he received permission to investigate it. In the following season, with only an Indian sketch map to guide him, he found a portage route from the east end of Lake Athabasca to northward flowing water, the Telzoa or Dubawnt River. Not knowing whether he was headed for the Arctic Ocean or Hudson Bay, he followed the river northward until it eventually swung to the east to Chesterfield Inlet at the northwest corner of Hudson Bay. There now remained, with provisions exhausted, the long paddle in canoes down the open waters of Hudson Bay to Fort Churchill and from there an 800-mile journey by snowshoe and dog-team to Winnipeg. The following season he was back crossing this region by another route, following the Kazan and Ferguson Rivers.

Early information regarding the great area lying to the east of Hudson Bay came from work of a similar character carried out by A. P. Low. Low crossed the Labrador Peninsula both in an east direction and in a north and south direction. He mapped some of the main streams and lakes and part of the coastline, and reported on the iron-bearing rocks

Dr. George M. Dawson, distinguished member of the Geological Survey and its third director, carried out important explorations in British Columbia and the Yukon.

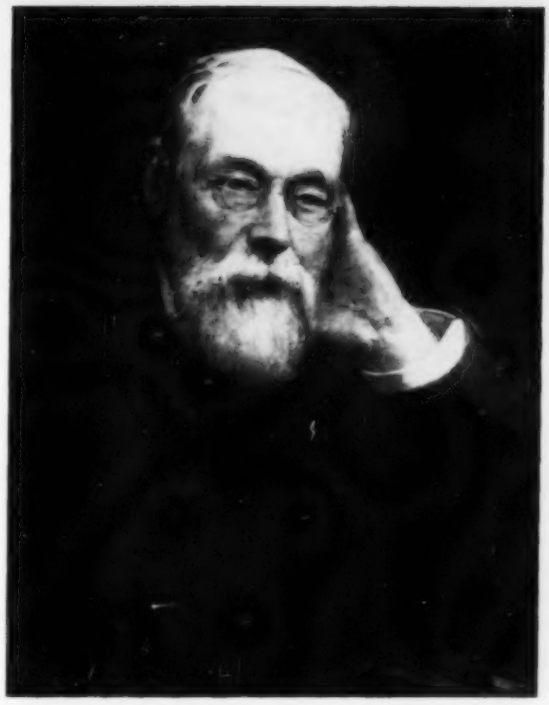
Dr. J. B. Tyrrell explored a large area north of the Churchill River.

Geological Survey of Canada



Dr. A. R. C. Selwyn succeeded Sir William Logan as director of the Geological Survey of Canada and did outstanding work in the interior of British Columbia and elsewhere.

Geological Survey of Canada



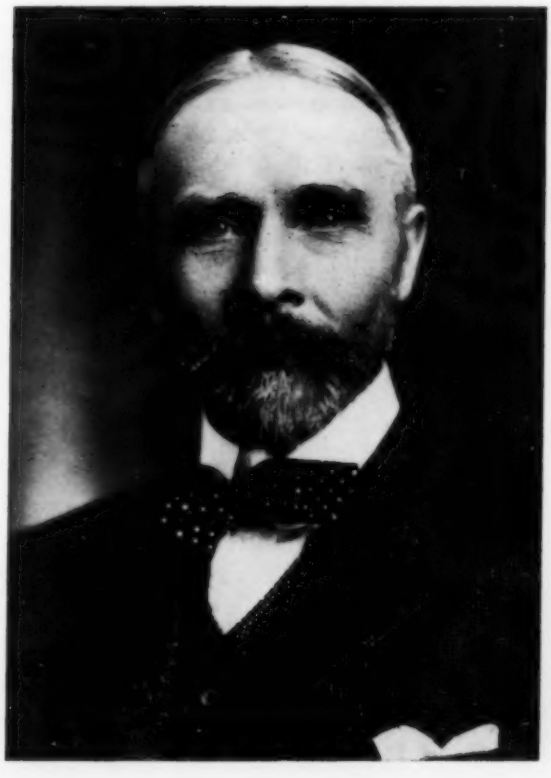
which are now being developed. In two years alone, those of 1893 and 1894, he travelled in this area 5,460 miles: by canoe 2,960 miles, on vessel 1,000 miles, with dog-teams 500 miles, and on foot 1,000 miles.

One other project deserves special mention, the Canadian Arctic Expedition of 1913-16, in which the Geological Survey co-operated with the Department of Naval Affairs. The leader was V. Stefansson, who explored Beaufort Sea and western Prince Patrick Land. A southern sub-party under R. M. Anderson operated in the neighbourhood of Coronation Gulf, Coppermine River and Victoria Land. It consisted of scientists who carried out topographic mapping and studies in geology, biology and anthropology which resulted in a series of notable reports.

The filling in of the map of northern Canada with the gathering of information about its resources is proceeding apace. Some problems have now been settled, for example that of the Northwest Passage. In 1903 Roald Amundsen left Europe in the seventy-foot *Gjoa* and after three winters in the Arctic reached the Pacific in 1906. In June 1940 Superintendent Larsen of the Royal Canadian Mounted Police left Vancouver in the eighty-ton *St. Roch* and sailing around the northern part of the continent reached Halifax in October 1942. On his return trip in 1944 he sailed through from east to west in a single season. Though much has been learned and is being learned about the broad areas of our northland, much more still remains to be found out and recorded. The days of romance and discovery in this connection are far from being over.

R. G. McConnell of the Geological Survey made significant contributions to the knowledge of British Columbia and the Yukon.

Geological Survey of Canada



Dr. R. M. Anderson, mammologist with the National Museum, played an important part in the Canadian Arctic Expedition of 1913-16.

National Museum of Canada

Reunion With Mikak

by HANS-WINDEKILDE JANNASCH

I WAS BORN and spent my childhood on the coast of Labrador. It was therefore not unnatural, when I visited the Ethnological Museum of the University of Göttingen, in Germany, that my interest should have been particularly caught by its Arctic Division. Indeed, sixty years of my life seemed for the moment to fade from consciousness as I found myself surrounded by the once so familiar clothing, weapons and carvings, and I was in memory back in that childhood spent among the Eskimos on the barren Labrador coast.

Professor Plischke, director of the museum, called my attention to a painting on the wall. It represented an Eskimo woman with her child, and was painted by an eighteenth century English artist, further details being unknown. As I stared at the picture, it was as though I could simultaneously see myself, a child at the mission station of Nain under the care of an Eskimo nurse, listening, as I played at the side of the cemetery, to a tale she told me. She told of Mikak, wife of the great magician Tuglavina. Their graves were nearby.

Rousing myself from absorption in the memories and train of thought to which they had given rise, I said to the professor, "This is presumably the portrait of Mikak and here is her story:

"On the occasion of a raid in 1768 twenty Eskimos were killed and some women and their children taken prisoners by the English. Among these women was Mikak, wife of a chief magician named Tuglavina, who had himself escaped. Her outstanding intelligence won the respect of Lieutenant Lucas of H.M.S. *Guernsey*. With his help she picked up English quickly. He took her and her small son to England, where throughout the following winter she was the great sensation of society. She was presented to the queen, who gave her a dress. Her portrait was painted by the well-known portrait painter, John Russell, and she is presumably wearing the dress in this picture. The dress later gave her especial influence among her own people, and it was carefully preserved and was in the possession of her grandson as late as 1870.

"A few years after her return to Labrador the mission station of Nain was founded by the Moravians. Fortunate for the success of this enterprise was the fact that Mikak and her husband welcomed it. Land had been allotted to the Moravians by King George III, and its boundary stones are still to be seen today. But negotiations for its acquisition, so far as the Eskimos were concerned, were carried on in an officer's tent that was given to Mikak by the British Governor Palliser. Mikak wore this very dress at the negotiations. It was before her tent, too, that the aged Greenland missionary, Drachart, preached in the Eskimo language his first sermon in Labrador. A few years later Mikak and her husband were baptized, thus giving a helpful impetus to the work of the mission. Later, it is true, as a result of temptations by dishonest traders from the south, they became disloyal and led a wild life. Toward the end of their lives, however, they returned, remorseful, into the bosom of the mission congregation. Mikak died in 1795, Tuglavina four years afterwards. They are buried at Nain."

At top:—The painting of the Eskimo woman, Mikak, with her son, by the English artist, John Russell. Captured and taken from Labrador to England by a party of raiders in the eighteenth century, she was later brought back to her home.

Professor Plischke was able to find in the archives of the museum confirmation of the identification. According to documents brought to light by the search, the portrait was painted at the order of Sir Joseph Banks, friend and patron of the great Captain James Cook, the circumnavigator of the globe. The picture was painted by John Russell, and was presented by Banks to Professor Blumenbach, an eminent scientist of Göttingen University, who was highly esteemed by both Cook and Banks. It hung in Blumenbach's own room until his death, after which it passed into the possession of the university. It is perhaps worth incidental note that, as a result of the respect which both Cook and Banks had for Blumenbach, the Göttingen Ethnological Museum possesses one of the best collections in existence of specimens gathered by Cook in the South Seas.

On the same wall with the picture of Mikak there were two other Eskimo portraits, for neither of which the museum had any explanation. I surmised that the Eskimos represented in these pictures were those taken to England in 1773 by George Cartwright.

This trader, whose name is still perpetuated in the name of one of the ports on the Labrador coast, was a typical representative of the "Age of Enlightenment". He believed that all that was necessary to bring the Eskimos to a realization of their backwardness was to take them on a visit to Europe and let them come to an appreciation, if not to a slavish imitation, of European civilization. His experiment was a complete failure, the story of which one can follow in the pages of his elaborate diary. The day Cartwright's party of Eskimos returned to Labrador one of the women, named Caubvik, became ill with smallpox. Contrary to all expectations she recovered, but the others had been infected by her and all died. Caubvik's hair was cut off, on the ground of its being infected. But she was so loath to part with it that she was eventually allowed to keep it. This proved her undoing, for a year later she was found in her tent, dead of smallpox.

Documents rediscovered in the museum's records confirmed this hypothesis also. The paintings are portraits of Caubvik and her husband, Attiuick. The ones hanging in the museum at Göttingen are, however, not the originals. The originals were painted by Nathaniel Dance and remained in the possession of Lady Banks. Sir Joseph Banks, however, had copies made by the painter Hanneman for presentation to Professor Blumenbach. They formed a significant part of the sources for Blumenbach's principle of the five human races, which replaced the Linnean scheme that had been accepted theretofore, and which dominated much of the whole idea of race in the nineteenth century — as older persons can today still remember from the geography lessons of their childhood.

This portrait of the Eskimo, Attiuick copied by the painter Hannemann from the original by Nathaniel Dance, is in a collection at the University of Göttingen, Germany.

A portrait of Caubvik, wife of Attiuick, copied from another Dance painting which is also to be found in the collection at the University of Göttingen. Caubvik died of smallpox after her sojourn in Europe.

Geologist, dogs and Peterhead schooner during a geological exploration of southern Baffin Island.

Old and New Ways In Arctic Geology

by Y. O. FORTIER

Geological Survey of Canada photographs and maps.

THE STUDENT of geology who has to search for exposures of bed-rock in many parts of southern Canada deals with different conditions when he investigates the far Canadian Arctic. What he loses in protection from the absent forest, he gains in facility of observation on the ground surface. Further, the last stages in the long evolution of that country have resulted in its parcelling into islands with many elevated coasts representing as many faces cut into bed-rock. This evolution has been such that the Pleistocene ice cover, which overburdened the bed-rock of the south with widespread debris of attrition and transport, either was non-existent in parts of the Archipelago, or its debris was washed away along coastal parts. At any rate, bed-rock is well exposed in the Archipelago; so much so, that one can read much of its geological evolution in the photographs of the whole insular region taken by the Royal Canadian Air Force.

Well-exposed bed-rock favours mineral exploration. Much of the larger part of the world's mineral wealth lies in bed-rock, formed up to over two billion years ago. Basically it does not result from geographical conditions that make present climates, although these effect both extraction and marketing. All of this holds for the Archipelago.

Some of the foregoing explains why much geological information is found in the recordings of Arctic travellers at various periods of exploration. As a result, some major features of the geology of the Archipelago were known at an early date when some of its potential mineral wealth became indicated. It was natural for the first Arctic dwellers, the Eskimos, to find flint to shape into tools, soapstone to carve into lamps, and in the south-west, copper to fabricate implements; but it does seem strange that they did not know coal as a source of fuel, since it is common in many islands.

Martin Frobisher's venture into Baffin Island in 1576 has many historical facets. For Europeans it marks the first recorded intrusion into the Archipelago, an early interest in its mineral content and a pioneer mining operation in North America, and for natural scientists it is the period of alchemistry pitted against nature. Indeed Frobisher's exploring endeav-

ours were soon channelled into extracting a worthless dark (gneiss) rock conveniently but mistakenly pronounced to be gold by an alchemist.

The travels and recordings of Edward Parry in the first quarter of the nineteenth century are a sign post in the study of the geology and mineral potential of the Arctic. The terrains he discovered were mainly classified by specialists, on the basis of his collections and notes, as primary and secondary in harmony with the science of geology as it then existed. Parry located coal and petroliferous strata on Melville Island and grains of chromite on Melville Peninsula. Soon refinement in geological classification of the islands became possible, through advancement in geological science and substantial and valuable recordings, especially of those engaged in the search for Sir John Franklin in the middle part of the century. In 1857 the Reverend Samuel Haughton compiled a first geological map of the known parts of the Archipelago. It has modern aspects and remained until a few years ago the standard geological reference for many islands.

In the same decade that Franklin sailed to his death an event took place in the administration of Canada which eventually was to have a substantial effect on the study of the geology and the examination of the potential mineral wealth of the Archipelago. It was in 1842 that the Geological Survey of Canada commenced its investigation of the Canadian domain, an investigation which at present is being carried out systematically and substantially throughout the Arctic. In its early days this governmental agency attracted men of valour in science and hardy endeavours. Through their achievements in geological and geographical exploration, the Geological Survey of Canada has become a national institution. Still very active, it is one of the oldest, if not the oldest, of the scientific bodies in Canada. From the Maritimes and Ungava, through the Barrens, the Shield, the Western Plains, to the Cordillera of British Columbia and the Yukon, Selwyn, Low, the Bells, Dawson, McConnell, Tyrrell and others in the later part of the nineteenth century were not only pioneering the study of geology and indicating potential mineral resources but also treading many a virgin path. Their energy soon carried them beyond the mainland into the Arctic and their achievements created a tradition that challenged their successors. Some of these are at present carrying on the tradition in widespread Arctic areas. But all their paths are not new, even if their ways and results are, and the chief emphasis here concerns the century or so that followed the Franklin tragedy.

After the Franklin search, the tempo of Arctic exploration was reduced and the main preoccupation of explorers, besides finding new lands, was reaching the North Pole. The expedition led by G. S. Nares up to the north coast of Ellesmere Island uncovered a third geological region of the Archipelago after the compilation of Haughton. In 1887 G. M. Dawson of the Geological Survey of Canada made a valuable compilation of available information on Arctic geology. However, the Survey staff were not in the Arctic in mind only. In 1884 Robert Bell, entering Hudson Strait and commencing the geological exploration of the coasts along the strait, was the first member of the Survey to be in action in the Archipelago and the first professional geologist to do any systematic Arctic mapping. In the early years of the twentieth century, A. P. Low explored and wrote at length on the geology of the coasts of southeastern Ellesmere Island, Devon and Baffin Islands. At the turn of the century Per Schei, geologist of the Second Norwegian Expedition in the *Fram*, made voluminous and pertinent observations and collected a wealth of data later studied by many specialists. The result of all this work was the commencement of modern stratigraphic investigation in the Archipelago. In 1913 the Geological Survey sent J. J. O'Neill and G. S. Malloch as geologists on the Canadian Arctic Expedition to the western Arctic, and in 1927 L. J. Weeks spent the winter mapping Cumberland Sound to Nettilling Lake. From 1938 to 1941 A. L. Washburn was a pioneer in modern geomorphic studies of the Archipelago.

These are some of the highlights of exploration which permitted a classification of the geological terrains and gave a preliminary outline of the potential mineral resources of the Archipelago up to the Second World War.

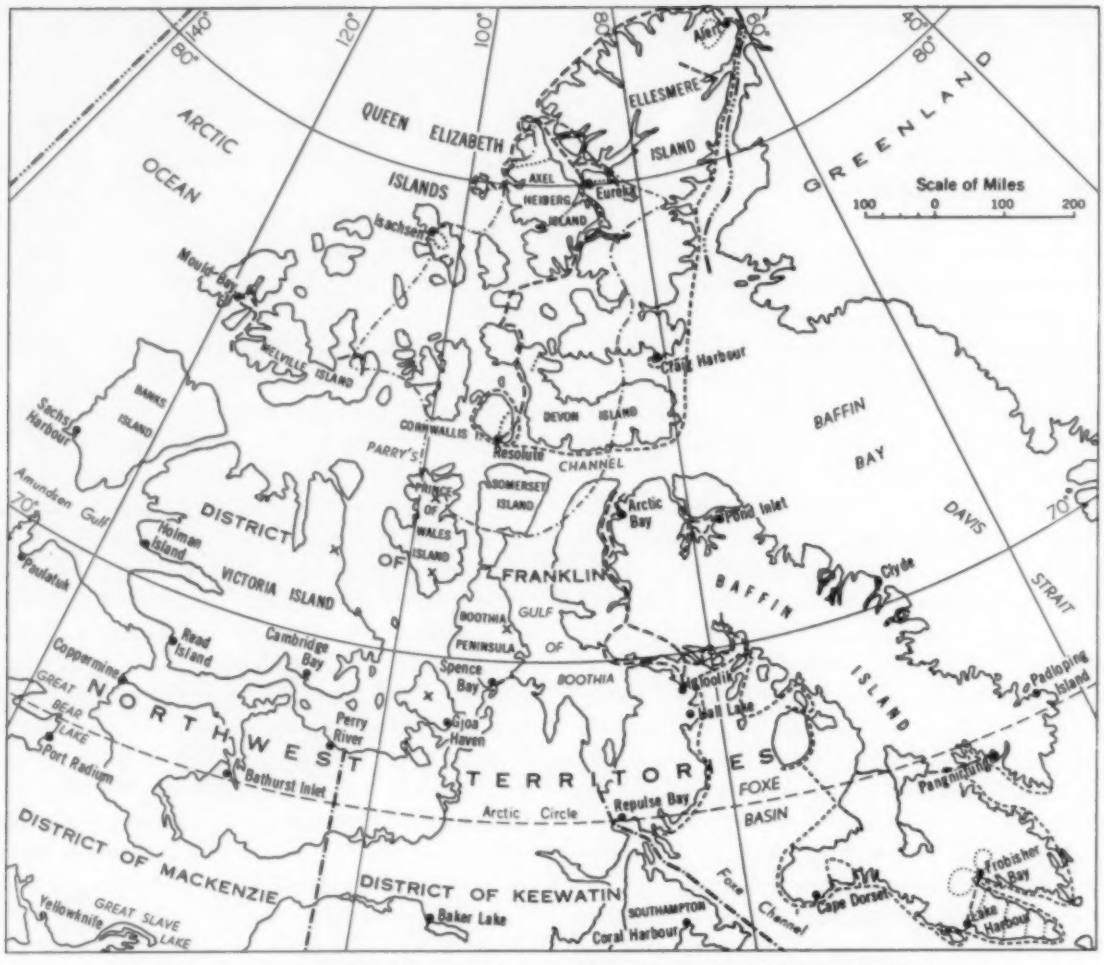


Figure 1 - Investigations by officers of the Geological Survey of Canada in the Arctic Islands. Travels by ship, schooner, whale boat, and by canoes...(--------). Journeys by dog-sledge...(— — — —). Walking treks...(.....). Area investigated by helicopter...(—·—·—·). Landings from cruising amphibian aircraft...(×).

Much more has been done since and as a result the first stage of geological exploration of the Archipelago may be brought to a conclusion within a decade or so. This progress has substantially derived from the activities of the Geological Survey, although individuals and institutes not related to the Survey are making valuable contributions. The present conditions of Arctic development have favoured such progress.

From the summer of 1947 to and including the summer of 1958, the Geological Survey has had in the field (see Figure 1) twenty-nine geological parties in the Archipelago. Besides, in 1955, a major project, Operation Franklin, employed eleven geologists and a few geophysicists over the larger parts of the Queen Elizabeth Islands and south of these islands. A few of these projects were carried out in association with other institutions, but in the main they were the whole responsibility of the Survey.

Staff members have travelled in all islands except Banks and central and west Victoria Islands. They have done so by well-tried means and by new techniques. Air transportation to the islands and in some instances within them has been a major and helpful factor. Staff members have cruised by Peterhead schooner, trap and whale boats along the coasts of southern Baffin Island from Foxe Channel to Cumberland Sound, in Eclipse Sound and Admiralty Inlet, and around Foxe Basin. Canoes have been used to explore inlets and rivers of Baffin Island, to circumnavigate Cornwallis Island,

and to travel along Eureka Sound and Bay Fiord. Packing dogs have been employed for extended overland trips in southern Baffin Island. *Komatiks* pulled by dog teams have been used on almost all the Queen Elizabeth Islands, on Somerset Island, and over widespread parts of Baffin Island. Some of the more interesting trips thus performed were by R. G. Blackadar in 1953 and R. L. Christie in 1954, both in the company of G. Hattersley-Smith, covering the north coast of Ellesmere Island. In 1957 R. Thorsteinsson went from Eureka, on central western Ellesmere, around northern Axel Heiberg Island to Meighen Island, where he found in the cairn built by the discoverer of the island, V. Stefansson, the last-known message of the late H. K. E. Krueger. E. T. Tozer travelled in 1957 from Cornwall Island, along southern Axel Heiberg Island, to Hat Island and back, thence to Table Island, and across Grinnell Peninsula to Resolute Bay, on Cornwallis Island.

Eleven geologists of Operation Franklin explored by means of two large helicopters that part of the Archipelago that stretches from southern Somerset Island to northern Axel Heiberg, from the middle eastern coast of Ellesmere Island to the Sabine Peninsula on Melville Island. This summer Thorsteinsson and Tozer conducted a novel experiment by covering the unmapped and larger part of Melville Island and the virgin group of Brock-Borden Islands by light aircraft. It is hoped that versatile light aircraft will make multiple landings at unprepared sites for ground examination economically possible. Interesting journeys by foot include repeated crossings of southern Baffin Island from Frobisher Bay to Hudson Strait, two crossings of Axel Heiberg Island, and extended treks over Ellef Ringnes Island to explore special dome structures. These are some of the highlights of modern geological activities in the Arctic.

These activities, as well as those of the past,

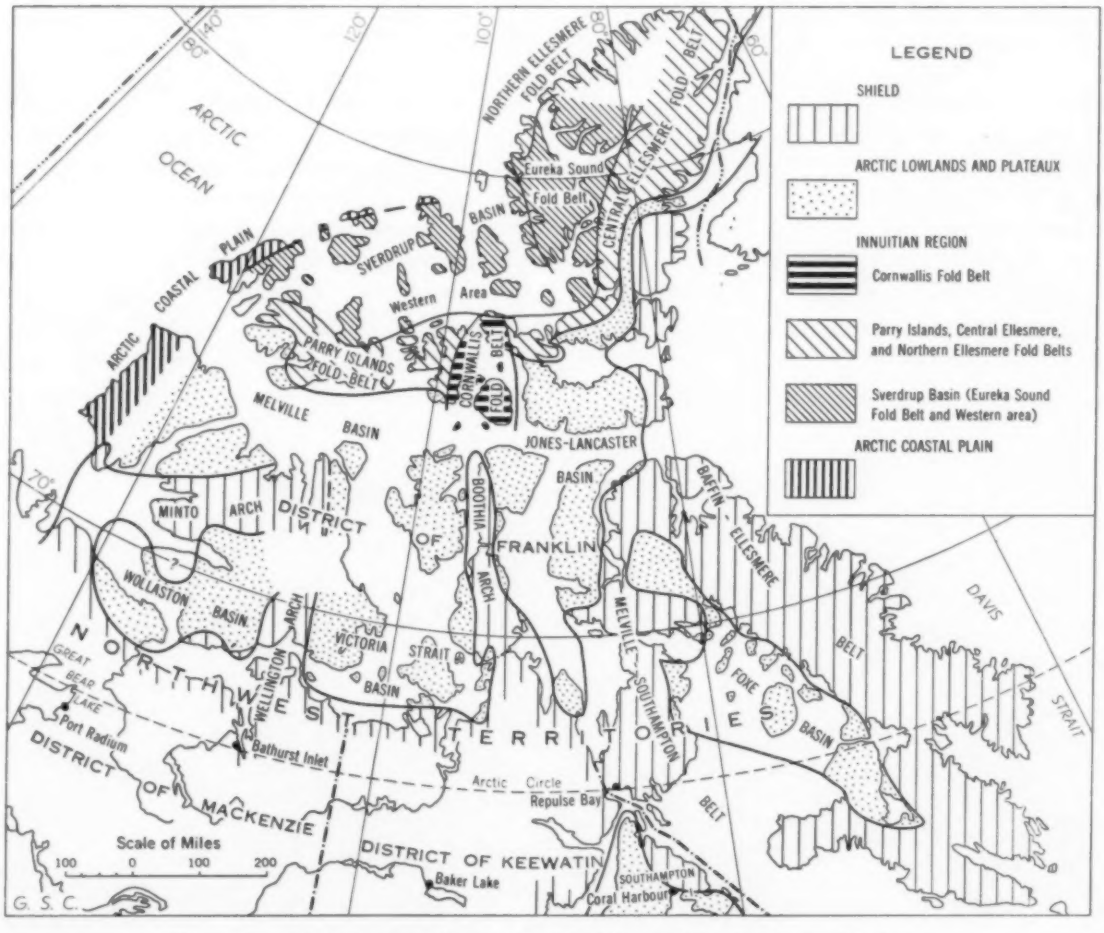


Figure 2 - Geological regions and subdivisions of the Arctic Archipelago.

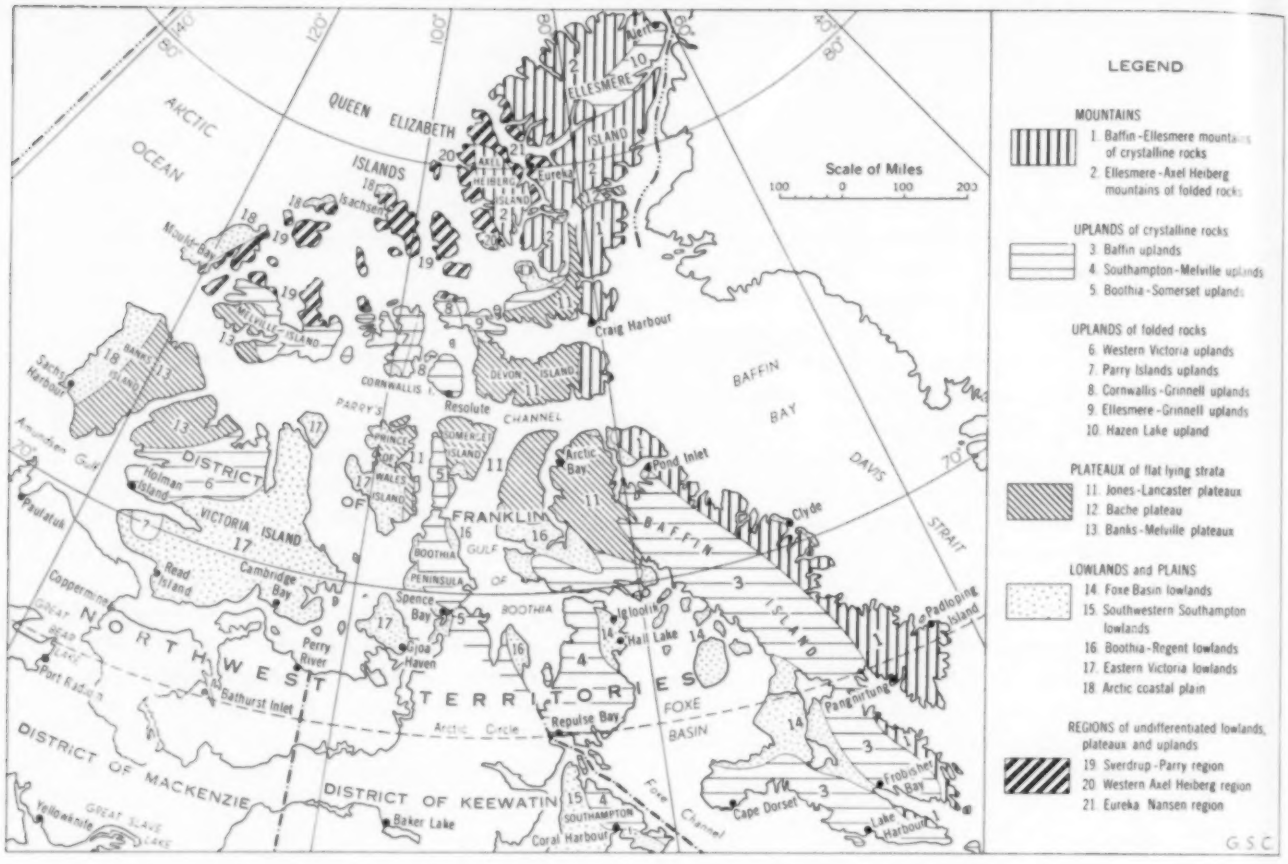


Figure 3 - Provisional physiographic divisions of the Arctic Archipelago.

have made possible the division of the Archipelago into geological provinces and subprovinces and provisionally into physiographic units (see Figures 2 and 3). The Geological Survey has recently classified much the larger part of the Queen Elizabeth Islands into the Innuitian geological region. The geological evolution of this region has been complex, spanning three periods of mountain building, from the middle Palaeozoic to the Tertiary, and probably a fourth and Precambrian one, in the crystalline terrains of northernmost Ellesmere Island. In the realm of continental evolution, it is similar to the Appalachian and Cordilleran regions, and like these it is separated from the Canadian Shield by a stable cover of strata at the periphery of the Shield. This cover forms the Arctic Lowlands and Plateaux, as it

The sign post erected at Cape Columbia on the north coast of Ellesmere Island to commemorate Admiral Peary's attainment of the North Pole.

An Eskimo participant in Operation Franklin sits on the anchor of the ship Fury, *which Sir Edward Parry abandoned on the southeastern coast of Somerset Island in 1825.*

does the Western Plains and the St. Lawrence Lowlands. The symmetry of geological evolution east, west, and north of the Shield, as well as the extension of geological and physiographic divisions from island to island, indicates that the Archipelago is part of the North American Continent and that its insularity is a very recent phenomenon.

This classification of the Archipelago into geological regions and further into subdivisions is fundamental to assess its potential mineral resources. The Shield part should contain metallic and non-metallic ores. Graphite has already been mined in Cumberland Sound and in the region of Lake Harbour. Iron ore is known from three localities in Baffin Island: near the Barnes ice-cap, between Amadjuak and Dorset, and on the north-east shores of Foxe Basin. (The latter two occurrences were discovered by the Geological Survey.) These occurrences are in metamorphosed layered rocks which originally may have been similar to the layers of the Labrador Trough. The Survey has also located a large body of sulphides in the district of Admiralty Inlet. Copper ores may well occur in terrains of Victoria Island said to resemble the copper-bearing measures of the Coppermine series on the mainland.

The Innuitian and the Arctic Lowlands and Plateaux regions are potential sources of fuel. Many occurrences of coal, mainly low grade but possibly up to semi-anthracite, are known in practically all the Queen Elizabeth Islands. They range in geological age from Devonian to Tertiary. Some of these occurrences overlie rocks of the Shield on Baffin and Bylot Islands, and have been mined on a limited scale near Pond Inlet for local heating needs. Although no live oil seepage has been authenticated in those regions, there are other indications of the petroliferous nature of some of the strata and many geological features of productive fields in other parts of the world are already known here. Some of these features as well as others serve to classify the Innuitian Region and the Arctic Lowlands and Plateaux into subdivisions, which is a further step in the mineral evaluation of the Archipelago. At least one of the subdivisions of the Innuitian Region contains numerous piercement dome structures with cores of gypsum. Besides their voluminous and possibly valuable content of gypsum, such structures may be favourable for the concentration of oil and gas as they sometimes are in other parts of the world. Further extensive but older gypsum measures lie in other subdivisions of the Innuitian Region and extend into the Arctic Lowlands and Plateaux, where they form at least one apparent piercement dome. As in other expanses of crystalline terrains, those of the north coast of Ellesmere Island within the Innuitian Region may harbour metallic and non-metallic ores including those found in association with ultrabasic rocks.

The climatic conditions which make the economy of the Archipelago difficult are only an ephemeral stage in a long and varied geological evolution. This evolution has potentially endowed the Arctic rocks with a variety of mineral resources as in other parts of Canada. Profit from such resources will depend on technological know-how and progress, as has been the case in the mineral development of other but less remote regions of Canada.

A geologist on Operation Franklin breaks camp on northwestern Devon Island to board a helicopter.

Archaeology in the Canadian Arctic

by WILLIAM E. TAYLOR, JR.

Author's photographs except where credited.

ARCHAEOLOGY in the Canadian Arctic is bluntly devoid of the pyramids, plazas, and polychrome pots that archaeologists like to pursue. There is not the grandeur of Maya ruins, the antiquity of Paleolithic Europe, the abundant artifacts of the Mississippi Valley, or the pleasant summers of British Columbia — centennial or otherwise. Rather, it is a matter of seal bones, flint fragments, bits of worked ivory, and small excavations beset by rain or snow. Its purposes, like Americanist archaeology in general, are to discover the history of prehistoric cultures, and to reveal the factors determining that history. It is very much in an adolescent stage, and, consequently marked by the vigour and bold ignorance of youth. Thousands upon contiguous thousands of square miles of our sizable Arctic area have never been investigated by an archaeologist.

Concerning pyramids and plazas, one may note that the prehistoric populations of Arctic Canada have always been restricted by environment to a semi-nomadic hunting economy. The more elaborate social systems and cultures of the world depended on a more productive economy — agricultural and pastoral usually — that released time and energy for further cultural development. For the Eskimo and his predecessor the eternal pursuit of game precluded a sedentary life and the towns, temples, merchants, and rulers that such a life engenders. The Arctic environment and the cultural pattern that developed in response to it were among the primary reasons the Eskimos never migrated to southern areas.

Archaeology hardly existed in nineteenth-century North America, and in the Arctic, not at all. Arctic explorers often described the camp sites they found but excavation was rare and analysis a tentative groping. One excellent example of such work was that done by the men of the Lady Franklin Bay Expedition of 1881-84, led by Lieutenant Adolphus Greely of the United States Army. Operating in the north-east corner of Ellesmere Island, they recorded and collected from many sites. A stone house ruin excavated by them at Lake Hazen was, at the time, the farthest northern record of permanent human habitation. Missionaries, traders, government officers, and whalers also collected specimens late in the nineteenth century. One of the most astute was Captain George Comer of the New England whaling fleet, after whom the famous Comer's midden at Thule, Greenland, is named.

Early in the twentieth century as the Arctic began to open, prehistoric material began to pour into museums. Vilhjalmur Stefansson returned magnificent collections from the Beaufort Sea coast, and his 1912 excavations at Barrow were the first in Alaska and the first by a trained anthropologist in the Arctic. Then on the Canadian Arctic Expedition, 1913-17, Diamond Jenness conducted careful excavations in the same area and in doing so began a career as Canada's foremost anthropologist. E. W. Hawkes, like Jenness, sent valuable samples to the National Museum of Canada from Hudson Bay, Hudson Strait, and the Labrador coast. Such collections date from the period 1906 to 1914; the catalogues were ignored during the war.

Following the war, Arctic archaeology had its roaring twenties — especially the eastern Canadian Arctic — as the Hudson's Bay Company, Royal Canadian Mounted Police, and exploring scientists moved into the area. At Pond Inlet, Sergeant A. H. Joy excavated a valuable and well-documented sample. The Hudson's Bay Company sent to Ottawa a remarkable and, at the time, puzzling collection from Coats and Mansel Islands. J. Dewey Soper collected material from all over Baffin Island, and then from Cape Dorset L. T. Bur-

wash sent a collection that was soon to become famous through the brilliant analysis of Diamond Jenness.

If Arctic archaeology can be given a beginning date, it must be 1925, and its godparents would be two articles in volume fifteen of the *Geographical Review*. In the July issue Jenness repeated his hypothesis on Copper Eskimo origins and summarized the interpretations of Kai Birket-Smith and Therkel Mathiassen, the ethnologist and archaeologist of the Fifth Thule Expedition, 1921-24. Their initial findings had just been published in Denmark and, as Jenness wrote at the time, their discoveries were "a flood of light". Mathiassen's excavations were the first comprehensive and systematic archaeological work in northern North America. However, Jenness's main feat was to analyse the Burwash collection and to isolate a separate cultural entity termed the "Cape Dorset culture." He considered it earlier than Mathiassen's newly-discovered Thule culture and later than Birket-Smith's postulated Paleo-Eskimo culture. Thirty-three years later Jenness's view is unaltered. Then in the October issue of the series, Knud Rasmussen and his expedition associates presented an English-language summary of the Fifth Thule Expedition results, including Mathiassen's description of the Thule culture and Birket-Smith's astute interpretation of Eskimo origins.

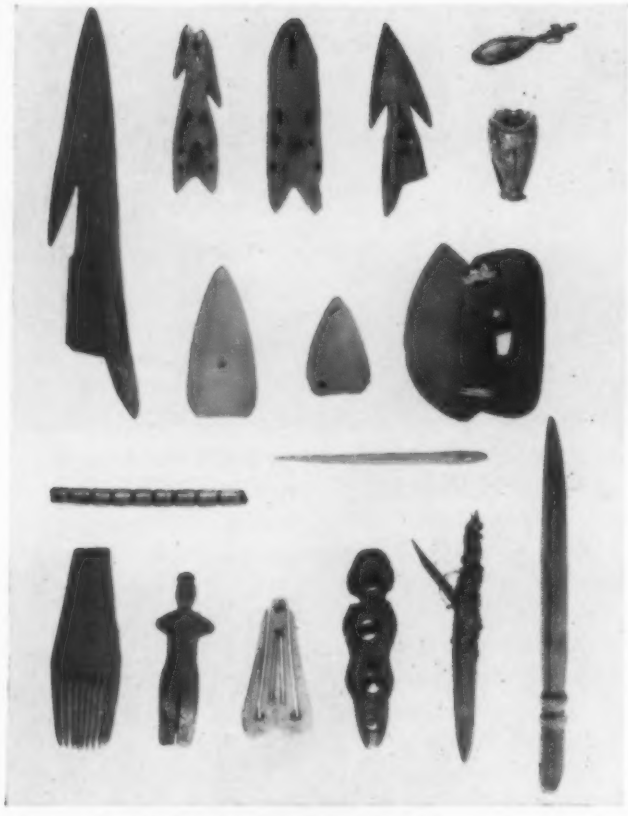
From 1925 to 1939, the archaeological picture in the Canadian Arctic continued to unfold generally in the eastern Arctic south of Lancaster Sound. Prominent in this work were T. H. Manning and G. W. Rowley on the Cambridge Canadian Arctic Expedition in Foxe Basin, Douglas Leechman and W. J. Wintemberg of the National Museum of Canada on Hudson Strait and Newfoundland, and W. D. Strong, Junius Bird, and G. I. Quimby on United States expeditions to Labrador and the Belcher Islands. These men and others built on the pioneer work of Mathiassen and Jenness and along with others in Alaska, Canada, and Greenland, they added more pieces and more meaning to the slowly assembling jigsaw puzzle of Arctic prehistory.

By 1939, it was clear that the whale-hunting Thule culture peoples had left the north Alas-

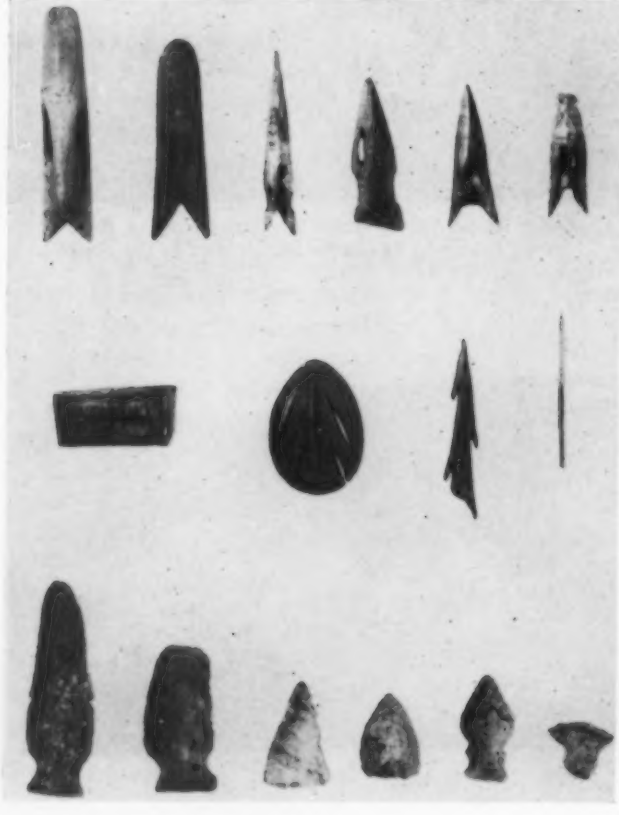
A Dorset culture house depression found at Payne Bay, Ungava, in 1957.

Henry B. Collins, Arctic specialist of the Smithsonian Institute, at Cornwallis Island in the Northwest Territories in 1950.

An excavated Sadlermiut house at Native Point, Southampton Island, in 1956.



Artifacts of the Thule culture of ivory, bone, antler, and slate. The larger harpoon heads with drilled perforations and the harpoon end-blades of rubbed slate show something of the contrast between Thule and Dorset culture equipment. The ivory object, third from left at bottom, was used to hold thimbles made of sealskin.



Cape Dorset culture artifacts. Row 1: harpoon heads. Row 2: so-called shaman's teeth, ornament, fish spear, needle. Row 3: flint knife, points and scraper. Dorset culture tools are marked by cut or gouged holes, for this culture did not know the bow drill. The weapons usually have blades of chipped flint. There are several types of harpoon heads, usually made of antler or ivory.

National Museum of Canada photographs.

kan coast about A.D. 900 and slowly migrated eastward through the Canadian Arctic. In the eastern Arctic two branches developed: one down the Labrador coast to the Gulf of St. Lawrence; the other north by Devon and Ellesmere Islands to Greenland. Greenland was not occupied by this culture until well after the arrival of the old Norse colonists. Sometime within the last few centuries there was a second Thule culture migration from east to west to re-occupy the old north Alaskan homeland. These Thule culture migrations do much to explain the cultural uniformity that typifies the Arctic coasts of North America.

In their extensive occupation of the eastern Arctic, the Thule peoples seem to have completely replaced their Dorset culture predecessors, who earlier had reached all around Greenland, south to Newfoundland, and at least as far west as Boothia Peninsula. In 1939, there was as yet no knowledge of Dorset culture house ruins nor any information about the physical type of its people.

After 1945, with the remarkable increase in travel facilities, archaeological research in the Canadian Arctic was accelerated. By then there was a considerable body of museum collections and sufficient archaeological knowledge to give some meaning to the clues these collections contained. These and other advantages were exploited with a more effective field method and more informative analysis techniques. Prominent in the last category are trait seriations, dendrochronology, and radio-carbon-14 dating.

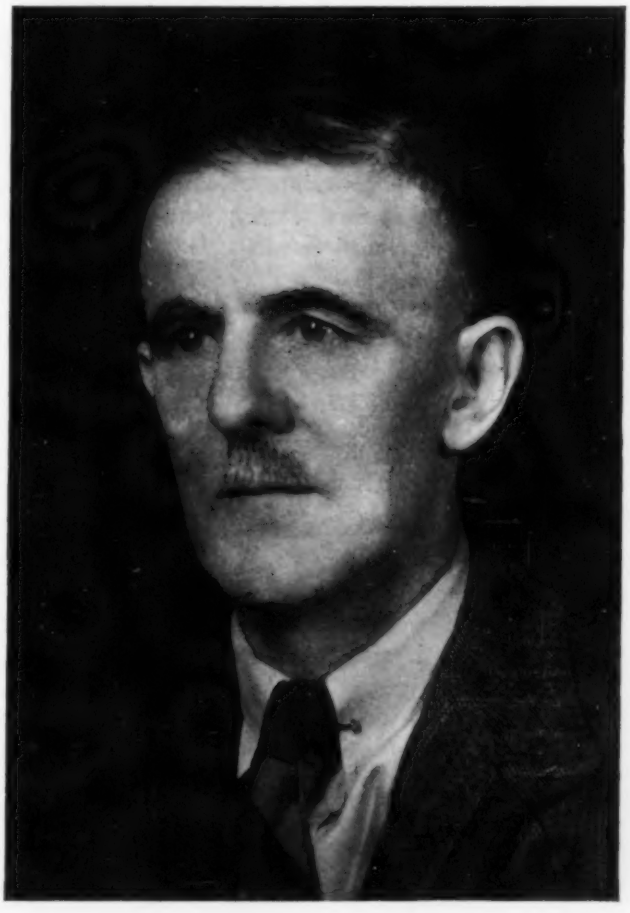
While several United States institutions pursued Alaskan problems and the Danish National Museum maintained its enviably active program in Greenland, the Canadian Arctic work fell largely to the National Museum of Canada. While welcoming other workers in the vast area, the National Museum developed a double program: one in the western Arctic, largely in a taiga environment; the other in the eastern Arctic tundra. Douglas Leechman for many seasons pioneered the work in the western Arctic, and for the past nine seasons Richard S.

MacNeish has been expanding and intensifying the program. While the concern here is partly Eskimo prehistory, it is strongly marked by a pursuit of the first human migrants to the New World, for it is generally held that the western hemisphere was populated by migration from Asia. MacNeish's research was undertaken throughout the District of Mackenzie and the Yukon Territory.

The eastern Arctic program was begun with the co-operation of the Smithsonian Institution and its Arctic specialist, Henry B. Collins, who had pioneered Alaskan prehistory since 1927. Despite his protests, Collins is regarded as the dean of Arctic archaeologists. From 1948 to 1955 he directed seven co-operative expeditions to Frobisher Bay and Cornwallis, Southampton, Coats, and Walrus Islands. And the double program continues — in 1958 there are parties in the north-west Yukon, along Hudson Strait, and in conjunction with the Defense Research Board's International Geophysical Year work, at Lake Hazen where sites discovered by Greely's expedition in 1882 are being excavated as this is written.

Outstanding among the efforts of foreign institutions in the Canadian Arctic is that of Jorgen Meldgaard of the Danish National Museum near Igloolik in the 1954 season. In a remarkable site complex that included over 200 houses Meldgaard found on successive old strand lines occupations extending back in time from Thule culture through five sequential stages of Dorset culture to a still earlier Arctic culture. This oldest culture was given the provisional term "Sarqaq" and it may extend to 2,000 B.C. It is in part related to recently studied sites in Greenland and has a marked relationship to very early sites in Alaska and the Yukon Territory. The honour of first describing Dorset culture houses, however, belongs not to Meldgaard but to Deric O'Bryan, who excavated such a house on Mill Island while working with an American expedition in Hudson Strait. Finally, in 1957, a National Museum of Canada expedition in Ungava found the first inland Dorset houses and, in addition, the first preserved human skeleton belonging to Dorset culture. Since it was typically Eskimo in physical type, it reinforces the hypothesis of an Alaskan origin for Dorset culture rather than Meldgaard's well-argued minority view that the Dorset culture represented a northward migration of Indians.

Each field season brings new and sometimes startling fragments to the jigsaw puzzle of Arctic prehistory and as the puzzle grows it is increasingly complex, larger, older, and more challenging. One begins by asking where the Eskimo came from. There remain two old lichen-encrusted schools of thought — the one, claiming the northern interior of North America as the original homeland, was once the orthodox view; the other, claiming Mesolithic North Europe and Neolithic Siberia as that homeland, seems on present archaeological evidence to hold more, albeit icy, water.



Dr. Diamond Jenness began his career as Canada's foremost anthropologist on the Canadian Arctic Expedition of 1913-17. It was he who first defined the Cape Dorset culture.

The Fisheries Research Board of Canada Arctic vessel Calanus *freezing into the ice at Igloolik Island, northern Foxe Basin, in October, 1955, in preparation for winter studies.*

Fish in the Canadian North

by H. D. FISHER

Photographs by the author

A GLANCE at any world map or globe reveals Canada's great but unmeasured northern coastline. Add to this the endless lakes, rivers, bays and other water areas from Beaufort Sea on the west to Baffin Bay and Davis Strait on the east and one cannot help but contemplate the fisheries potential of this vast area. Unfortunately, however, these waters are very cold and conditions generally are unfavourable to sustain prolific fish and marine animal life. The Canadian Fisheries Expedition of 1930 to Hudson Bay, and the North West Canadian Fisheries Surveys of 1944-45 offered convincing evidence that intensive commercial exploitation of Canadian arctic fishery resources for export is not possible. With low temperatures and long winters, the fish grow slowly and mature late. They are in a relatively early phase of establishment in the various water systems after the recession of the last Ice Age. In areas where the stocks might be large enough to sustain moderate commercial export (for example, the Mackenzie Delta and adjacent areas), transportation costs at present would be extremely high.

One important exception to all this has been Great Slave Lake. The 1944 surveys indicated possibilities for a commercial fishery there, based mainly on whitefish (*Coregonus clupeaformis*), lake trout (*Cristivomer namaycush*) and ciscoes (*Leucichthys* sp.). It was conservatively estimated at that time that Great Slave Lake could yield a total fish catch of about 4,500,000 pounds annually. In 1945, commercial fishing began, and has continued since. Further studies and experience have justified an upward revision of the catch quota to 9,000,000 pounds and production has recently been close to 8,000,000 pounds a year. This fishery is interesting in that in no other case that we know of has it been possible to have a good body of scientific data on a water system of this kind before commercial exploitation began. Careful scientific surveillance is being maintained by the Fisheries Research Board of Canada's Biological Station at London, Ontario, through a sub-station

at Hay River, on the effects of the fishery. A recent review of the first ten years of commercial fishing on the lake indicates that the present order of catch can be sustained and possibly even increased.

Great Bear Lake, in spite of its great size, was found by the 1944-45 surveys to be very deep and of low productivity with only a fringe of fish life close to its shores. It does, however, support enough fish to be of importance to the local economy.

All of the fish stocks in the Arctic (anywhere in the tremendous mosaic of lakes and rivers that lie across the Northwest Territories, fish can be found) are of great importance or potential importance to the local economy. With a few exceptions, the native peoples of the north are basically meat-eaters. On the coast marine mammals and in the interior Barren Ground caribou form the traditional basic food resources. The numbers of caribou have declined to such an extent that they no longer can be depended upon as a reliable food source. Marine mammals on the whole already are being well utilized. Fishes are being increasingly looked to as a logical supplement.

It therefore has been necessary to follow up the fisheries surveys of 1930 and 1944-45 with research programs designed to determine what species are present and their relative abundance and catchability, and to carry out life-history work to provide an estimate of yields in various places. The utilization, economics and biology of marine mammals, particularly the important walrus (*Odobaenus rosmarus*), ringed seal (*Phoca hispida*) and white whale (*Delphinapterus leucas*) are also under study, to provide a basis for management.

This type of work began in 1947 and has developed until today all the Arctic work of the Fisheries Research Board, except for the continuing study of the Great Slave Lake fisheries and the physical oceanographic program, is incorporated in a program being carried out by an Arctic Unit, based at Montreal. The work is directed along the three main lines of fisheries, marine mammals and biological oceanography.

All the factors which make it impractical to exploit fishery resources in the isolated areas also make scientific work in those areas arduous and expensive. Canoe and bush-aircraft are still the main means of transportation for investigators. In September 1956 an aircraft bringing a fisheries research party south from Coppermine disappeared for three weeks and touched off one of the largest air searches that the Royal Canadian Air Force has ever carried out in the Arctic. When the party was finally rescued from a small lake north of Great Slave, the subsistence value of the freshwater fishes of the Arctic had been impressed upon them in a way they had not expected and are not likely to forget.

Two summers ago the Fisheries Research Board and the Canadian Wildlife Service teamed up to do a preliminary survey of fish stocks in Pelly and Garry Lakes of the Back River, just south of the Arctic Circle. The lakes were found to be well enough stocked with whitefish, lake trout and cisco to support organized subsistence fishing should this be desirable in the future.

In the winter of 1955 the Arctic Unit's fifty-foot diesel ketch *Calanus*, which has been operating in the Arctic since 1948, was frozen into Turton Bay of Igloolik Island in northern Foxe Basin to provide living quarters for two men. They made oceanographic observations throughout the winter and carried out as well studies of walrus and ringed seal. This summer the final phases of a ground study of walrus in Foxe Basin and northern Hudson Bay were to be completed. The *Calanus* is still in Foxe Basin, and a party will try to sail her south this

A typical Baffin Island char stream, showing the stone dams with which Eskimos trap the migrating char. This is on the south coast of the island.

fall to James Bay. From there work will begin next year on the walrus of the Belcher Islands area.

One of the most interesting studies, scientifically, has been that carried out in Ogak Lake, at the head of Ney Harbour, Frobisher Bay. This lake is separated by a very narrow sill from the fjord. About once a month high tides spill water from the fjord into it via the stream channel draining the lake. The lake is a brackish lagoon and since it is considerably warmer than the outside salt water it contains a relic fauna of forms from the most recent warmer times. The most conspicuous element is a population of Atlantic cod (*Gadus callarias*), not found in the immediate outside region. The cod seem to anticipate a high tide spill and gather at the river outlet just before this happens to gorge on the incoming plankton. Otherwise they live on each other. The lake is a natural laboratory for the study of environmental conditions, so the study will help to increase understanding about the factors limiting the northern distribution of many marine forms of life.

The Ogak Lake work is being followed up this year by study of the northernmost lake of any appreciable size in the world. This is Lake Hazen in northern Ellesmere Island. A biological study of this lake and its sizable stock of Arctic char is part of Canada's participation in the International Geophysical Year program. Studies of Arctic char from here will be compared with similar studies from such widely scattered localities as Firth River in the Yukon, Coppermine, Rowley Island in Foxe Basin, western Hudson Bay, Belcher Islands and Baffin Island. We will soon know enough about the life-history of Canadian Arctic char to form the basis for management of any stocks which are exploited.

There has been no reason, from the results of recent Arctic fisheries research, to alter the general conclusions of the Hudson Bay Fisheries Expedition of 1930 or the North West Canadian Fisheries Surveys of 1944-45, as far as prospects for commercial exploitation are concerned. There is a need for management of the present utilization of Atlantic walrus. Increased utilization of white whales and ringed seals is possible for many areas but again not on a scale to encourage commercial export. It is obvious that the fish stocks almost anywhere in the Arctic can stand increased utilization in the form of more and better organized subsistence fishing, or small local commercial projects, wherever these appear to be feasible. Mostly this applies to freshwater and anadromous species, such as the whitefishes, lake trout, ciscoes, inconnu and Arctic char.

The possibilities of establishing a luxury market for the char, which is a delicacy as a fresh food, and the establishment of small-scale native fishing projects is under study by the Department of Northern Affairs and National

Right:—An Eskimo, employed by the Fisheries Research Board, tags walrus off Coats Island by lancing marked discs into their hides.

Resources. It may be tried soon on an experimental scale at Frobisher Bay. Yields from individual rivers would be small (in the order of 10,000-20,000 pounds) but production could be spread over a number of streams.

There is hope that Greenland halibut (*Reinhardtius hippoglossoides*) exist off the east coast of Baffin Island in sufficient abundance to use. This is an important fish in the Greenland economy. Plans for exploratory fishing are being laid. Another fish of potential value is the Greenland shark (*Somniosus microcephalus*) which has a tough tannable skin and plentiful liver oil rich in Vitamins A and D as well as an unusually high content of certain glycerol ether-alcohols. It is the basis of the oldest fishery of Greenland, but is not as yet utilized in Canada. It occurs in Ungava Bay, Davis Strait and Baffin Bay.

When Arctic char were being investigated at the mouth of the Firth River, near Herschel Island, they were found to be feeding on young stages of an Arctic cod (*Eleginus* sp.) which is fished intensively in the Soviet Arctic and which is a great delicacy there. They call it *navaga*. A small make-shift drag was tried a little offshore, and marketable size *navaga* were taken. True herring (*Clupea* sp.) are also taken from the shore in nets in the western Arctic and may represent a fair stock in the Beaufort Sea. The Bowhead or Greenland whale has been under protection in the Arctic since its near elimination by commercial whalers in the late nineteenth century. Commercial exploitation is not foreseeable within twenty-five years, but recovery seems to have been good enough to allow a limited native catch if desirable. Natives from Point Barrow, Alaska, take a dozen or so Bowheads each year. An experimental fishing vessel for research in the western Arctic is being designed, and soon will throw further light on these possibilities.

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Right:—An Eskimo catching Arctic char below a stone dam.

A herd of walrus on the rocks near Coats Island.

An old bull walrus with tusks worn down.

Sheep can be successfully ranged on tundra near Fort Chimo in the Ungava Bay region of Northern Quebec.

Agricultural Research In Sub-Arctic and Arctic Canada

by F. S. NOWOSAD

Photographs by the author.

INTEREST in the agricultural possibilities of the more northern parts of Canada has been gradually increasing in recent years. During the Second World War and since that time, more and more people have visited and lived in the North for one reason or another. One of the main reasons has been the increasing interest in the search for and development of natural resources in the northern parts of the provinces, the Northwest Territories and Yukon.

As information on the possibilities of growing crops and of general farming in the northern remote areas was sketchy and intermittent, it

became evident that an organized programme of research on the soils and farming was necessary. The Dominion Department of Agriculture has from time to time sent agricultural survey parties into the North to assess the agricultural possibilities and to recommend agricultural research in certain areas. In 1944, an Experimental Sub-Station was established at Mile 1019, Alaska Highway, at 60° 45′ north latitude, 137° 35′ west longitude, in the Yukon. In 1946, another sub-station was located at Fort Simpson, at 61° 52′ north latitude, 121° 21′ west longitude, the junction of the Liard and Mackenzie Rivers in the Northwest Territories. In 1955, another sub-station was begun at 58° 07′ north latitude, 68° 07′ west longitude, in the Ungava Bay region, near Fort Chimo in northern Quebec.

The main purpose of these agricultural research stations is to study and collect information on all phases of agricultural problems in areas where some commercial agriculture appears feasible. In addition to the work at these specific locations, there are numerous co-operative tests with residents in more remote places that have specific or local problems. Fort Simpson Sub-Station, for example, is at present engaged in developing gardens, landscaping, and so on, at East 3, the new townsite of Aklavik. This location is the most northerly of all research centres, being at 68° 22′ north latitude, 133° 44′ west longitude, or some 127 miles north of the Arctic Circle.

Yukon Territory

Exploratory soil surveys during 1943 and 1944, mainly along the Alaska Highway, indicated that there is possibly half a million acres that might be termed arable land in that area. In 1957, a more concentrated soil survey was begun of the Takhini-Dezadeash Valleys, where the largest area of arable land was found. The sub-station at Mile 1019 is located in the Dezadeash Valley. Published progress reports are now available on the experimental results with field crops, horticultural crops, livestock and poultry. In most years certain varieties of barley and oats can be readily matured. Olli barley has performed well, producing twenty-five to forty-five bushels per acre. Good feed grades of oats have been possible from Larain, Exeter and Abbegweit varieties; some years up to sixty bushels of grain per acre have been recorded. Wheat, on the other hand, is not so dependable; only in 1953 was it possible to obtain a fully ripened sample. However, feed grades of wheat suitable for livestock sometimes reached a thirty bushels per acre yield. New varieties and selections are constantly being tested with a view to early maturity and adaptability in this area.

Many horticultural crops have been tested at the sub-station with varying but encouraging results. Some crops could not be grown successfully outdoors and must be grown in greenhouses or hot beds. Greenhouse culture has been successful with Quebec 152, Early Chatham and Early Lethbridge tomatoes, Surecrop Hybrid and Marketer cucumbers, and Tendersweet peppers. Crops that do not perform well in the garden are beans, parsnips, onions from seed, sweet corn, pumpkins and other tender vegetables that are easily affected by light frosts. The choice of small fruits is very limited and not too dependable. Occasionally raspberries produce well, as do gooseberries and strawberries; but a great deal of work remains to be done on the methods of winter protection and choice of varieties for a successful crop.

Each year, new species and varieties of annual flowers are being tested and the list for successful planting is continually revised. The interest in ornamental varieties is increasing with the growth of population in the settled areas.

Various classes of livestock can be raised here, for it has been shown that feed supplies can be produced locally. Dual purpose Shorthorn cattle have been increasing here steadily and no unusual obstacles have been encountered. Beef breeds are being introduced. According to several reports, cattle of the Highland breed can be raised without any supplementary winter feed in certain sheltered areas.

In recent years, hogs have been raised, using locally grown grains for feed as much as possible. Sheep have not been tried at this station, but plans are being made for the future.

Considerably north, but somewhat more in the interior, at Dawson, crops of potatoes,

carrots and most common vegetables can be grown. At Carmacks and Keno Hill potatoes are successfully produced on a commercial scale. Here a few greenhouses and hot houses may be observed.

The most northern settlement in the Yukon growing some vegetables is Old Crow at 68° 05′. This location is at about the same latitude as East 3, but it is deep in the mountainous area of the Porcupine River, which feeds the Yukon.

Northwest Territories

This vast area is estimated to contain about one million acres of agricultural land. These are located along rivers and streams, mainly in the Mackenzie River valley. The Fort Simpson Sub-Station serves the region from Fort Smith on the northern boundary of Alberta and north throughout the broad valley of the Mackenzie River to Aklavik. There the climate is not quite as severe as at Mile 1019 in the Yukon, but it is still the limiting factor in obtaining satisfactory crops. Spring wheat has attained maturity and a good grade; about forty bushels per acre have frequently been obtained from Thatcher and Saunders varieties. Coarse grains, therefore, can be grown and varieties such as Beaver and Victory oats or Newal and Olli barley give successful crops. Alfalfa can be grown for hay and often yields of 1.25 to 1.75 tons per acre are recorded.

The list of successful horticultural crops is longer at Fort Simpson than at Whitehorse, and even early tomatoes occasionally ripen in the field. Bush or Butter beans can be grown in the open, and varieties such as Round Pod Kidney and Stringless Green Pod have been successful. Broccoli, Brussels sprouts and cabbage are hardy enough to be set out in the garden after being started under glass. Cabbage is particularly useful, even as far north as Aklavik. About the only crop that fails at Fort Simpson is sweet corn. Occasionally, Orchard Baby, Pickaninny and a few hybrids can be grown to marketable stage, but corn growing is not recommended in the Northwest Territories.

Some common vegetables like potatoes, cabbages, turnips, carrots, radishes, lettuce and sometimes peas can be grown considerably north of Fort Simpson. Fort Wrigley, Fort Norman and Fort McPherson, for example, frequently have good gardens. The main consideration is that of early varieties and in some cases proper additional fertilization and cultural practices. These problems are under continuous study at Fort Simpson.

An interesting observation was made at the new Aklavik townsite at East 3. Common vegetables have been grown regularly at Old Aklavik, where the soil has been warmed up and activated considerably during many years of cultivation. East 3 is located some thirty miles due east and it can be assumed that the climate is similar. After removal of trees, the soil was cultivated and prepared for cropping. In 1956 permafrost was found fourteen inches under the surface, and as a result crops planted thereon germinated poorly and grew slowly. Only an odd blossom, for example, was observed on garden peas. The following year the same area was planted to garden crops. By 1st August the active layer of soil was three feet deep before permafrost was encountered. Crops in general looked fairly healthy and some green peas in the pod were obtained from certain varieties. Potatoes did not do so well, but it is believed that in a year or so they will produce, as they regularly do when permafrost recedes to more than four feet.

Ungava Bay Region

This whole area with sub-Arctic conditions has a climate which is more severe than at Whitehorse or Fort Simpson. It has somewhat less permafrost than at Aklavik, East 3, but good soil is scarce. The sub-station site chosen is not very far north according to latitude; for being at 58° 07′ north latitude, it is south of Fort Vermilion, Alberta. It is, however, about 700 miles north of the nearest agricultural settlement in the Lake St. John region in Quebec, and is typical of the many such areas on rivers and the sea along the north shore of Quebec and Labrador.

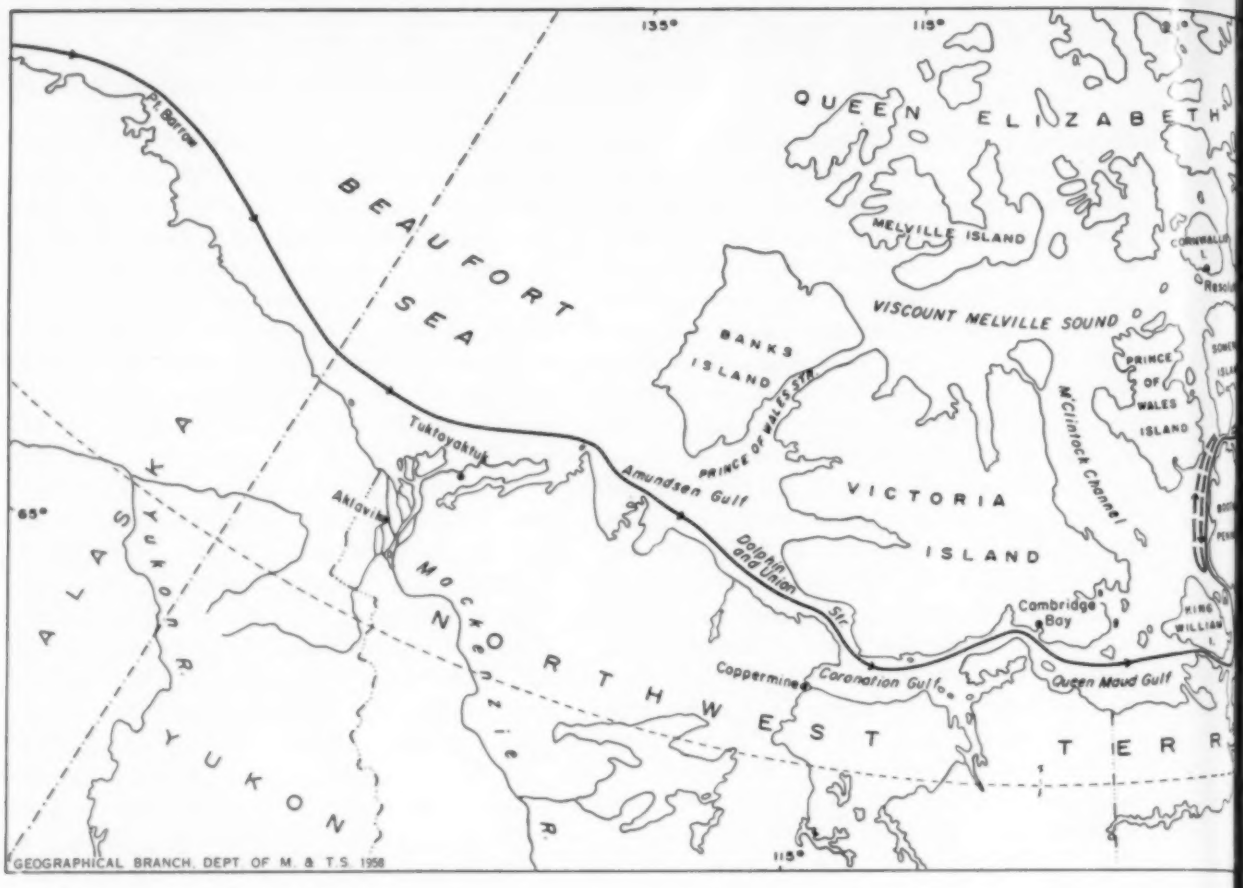
Information is now available to show that the soil must be properly fertilized in order to produce certain crops. For example, Olli barley has produced mature seed when fer-

tilized with 100 pounds of ammonium phosphate. Without this fertilizer the barley hardly headed out. Some common vegetables can be grown in the open field but not very regularly. Research is now directed to the use of plastics for constructing cheap greenhouses and cold frames to produce the more tender crops.

Sheep have been raised successfully, for there is plenty of summer browse. The biggest problem is winter feed, as there are no natural hay meadows; but it is believed that oat bundles and cultivated hay crops can be grown for this purpose. Domestic geese of the Pilgrim breed have been flown by aircraft into this region and after the first three weeks of indoor feeding were raised successfully on the native vegetation. In the fall some feed grains were given again, and by mid-September the birds averaged over thirteen pounds in weight. Laying hens were raised at Fort Chimo from day-old chicks and were kept throughout the year. No extra heating was necessary during the last two years and the egg production from last January to April was seventy, sixty-four, fifty-six, and forty-six per cent respectively. In 1958 eggs produced at Fort Chimo were incubated and chicks were successfully hatched for the first time — an achievement which created considerable interest in the community.

Agricultural development is limited in this area, but kitchen gardens and side-line farming may be successfully undertaken. Information is being sought on the method of reclaiming tidal flats of good soil along the False River, an area typical of many locations in northern Quebec where mining and other occupations point up the need for this research.

An Eskimo family with Pilgrim geese from the range near Fort Chimo in Northern Quebec. The climate here in the Ungava Bay region is more severe than at Whitehorse or Fort Simpson.



Operation Bellot

by C. J. MARSHALL

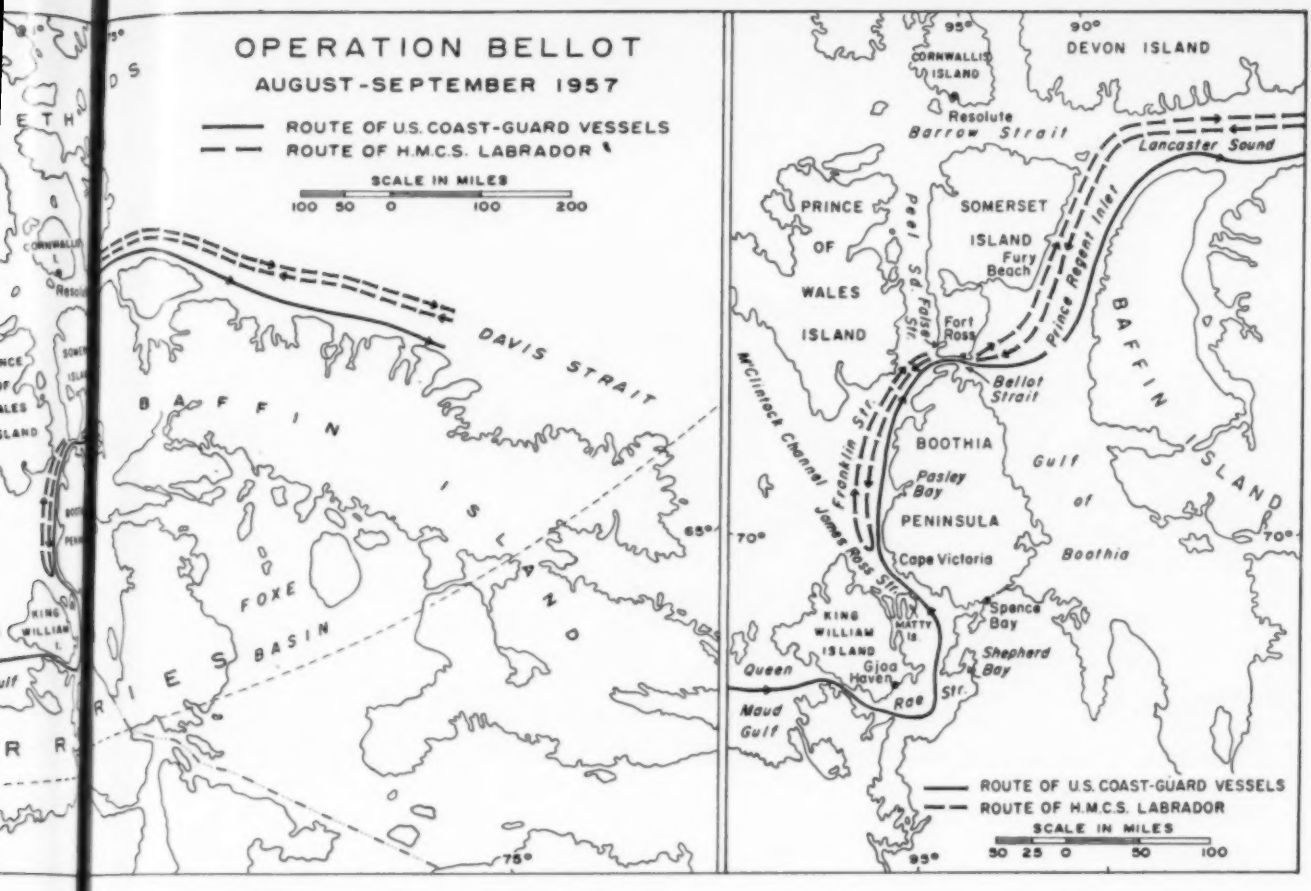
Department of National Defence photographs.

THE SEARCH for the Northwest Passage is one of the longest and most colourful episodes in the annals of North American exploration. During the summer of 1957 the final chapter was added by the Canadian and United States ships which took part in a joint survey project known as Operation Bellot.

The term, Northwest Passage, is used to describe a navigable water route between the Atlantic and Pacific Oceans, north of the North American mainland. A glance at a map suggests there might be a number of routes through the Arctic Islands, but after centuries of searching, it appears that there are only two which are likely to be of practical value. Superintendent Henry Larsen pioneered both of these routes in the little R.C.M.P. patrol vessel, *St. Roch*, and in 1954, a detailed survey conducted by H.M.C.S. *Labrador* established that the northern route through Barrow Strait was suitable for deep-draft ships. Operation Bellot determined the practicability of the southern route which runs along the mainland coast and in the process brought the age-old quest for the Northwest Passage to an end.

A water route to Asia was the goal sought by most of the early explorers who came to the Western Hemisphere and before long it became evident that if such a passage did exist, it would probably lie to the far north. Sir Martin Frobisher was one of the first of the early mariners to enter arctic waters when he explored the southern coast of Baffin Island in 1576, and during the next three centuries scores of expeditions followed. Some, like those of Parry and Amundsen, resulted in notable feats of exploration; others, like those of Hudson and Franklin, ended in disaster.

The quest for the Northwest Passage reached its peak after the Napoleonic wars in the



period from 1820 to 1860. During that time scarcely a year went by that some group did not set out to continue the exploration of the Arctic and while the ten-year search for Franklin was in progress no less than sixteen expeditions visited the area. It was during the Franklin search that someone first succeeded in travelling through the Arctic Islands from ocean to ocean, although part of the journey was carried out on foot. In 1850, Captain Robert M'Clure set out from England in the *Investigator* to look for Franklin in the western Arctic. Sailing around Point Barrow, he made his way as far as northern Banks Island before his vessel became beset in the ice. After spending two winters in the area, M'Clure finally abandoned his ship and set out eastward across the ice on foot. He succeeded in reaching Beechey Island, where he was picked up in the spring of 1854 by a British vessel and returned to England. M'Clure thus gained the distinction of being the first person to complete the Northwest Passage.

A great deal of information was collected during the search for Franklin and most of it suggested that if there was a water route through the Arctic Islands, it would be of little practical value to sailing ships because of ice and weather conditions. As a result, the quest for the passage was practically abandoned after the fate of Franklin was determined in 1859, and almost half a century passed before the first vessel made its way from the Atlantic, through Arctic waters, to the Pacific. In 1903, the Norwegian, Roald Amundsen, set out from Europe in the seventy-foot *Gjoa* and after three winters in the Arctic, reached the Pacific in 1906.

Superintendent Larsen is justly famous for the part he played in the exploration of the Northwest Passage. He made the first voyage from west to east, the first passage in a single season, and is still the only person to have made the passage in both directions. In addition, he pioneered the only two routes which are likely to be of practical value. Setting out from Vancouver in June, 1940, he sailed the eighty-ton *St. Roch* around Point Barrow, along the northern coast of the mainland as far as Boothia Peninsula, through Bellot Strait and

eventually reached Halifax in October, 1942. On the return trip during the summer of 1944, Larsen sailed through Lancaster Sound, Barrow Strait, Viscount Melville Sound, Prince of Wales Strait and thence out to the Pacific.

The final phase in the exploration of the Northwest Passage has come in the last decade as Canadian and United States ships have gathered the detailed information needed to complete the picture. Their task has been to determine whether the success of Amundsen and Larsen was due primarily to good luck and the use of small vessels or whether there really was a practicable route which deep-draft ships could hope to use regularly. In this work the seasons of 1954 and 1957 were particularly significant. In 1954, H.M.C.S. *Labrador* followed Larsen's northern route through Barrow and Prince of Wales Straits, carrying out detailed surveys as she went. In the process, it was established that this route was suitable for deep-draft ships, and the *Labrador* became the first naval vessel to complete the Northwest Passage. During 1957, Operation Bellot established the practicability of Larsen's southern route, which runs along the mainland coast through Bellot Strait to Prince Regent Inlet.

Despite its interest and significance, Operation Bellot was the by-product of an entirely different project. In the planning of the DEW line, it was decided that as many of the sites as possible should be supplied by ship. However, such a large-scale sea-supply operation required considerable hydrographic information, which was not available, and from 1955 to 1957 extensive surveys were carried out in both the eastern and the western Arctic. As a result of this work, most of Larsen's southern route along the mainland coast had been examined in detail by the end of the 1956 season and found to be suitable for deep-draft ships. The only blank area was the section from Shepherd Bay to Prince Regent Inlet. Although this section was an obvious link between the eastern and western Arctic, it had not been travelled by half a dozen vessels up to that time and was almost completely uncharted. A proper survey of the area was obviously necessary before the story of the Northwest Passage could be called complete and if the waters were found to be suitable for larger vessels, a second passage between the Atlantic and the Pacific would be available. Such a route would be of great potential value, because the ships which supply the western portion of the DEW line are always in danger of being trapped in the Arctic if the polar ice closes in on Point Barrow at the end of the season, and a passage through Bellot

Right:—The northernmost tip of the North American mainland forms a massive background as H.M.C.S. Labrador *makes a return trip through Bellot Strait.*

Left:—A triumphant procession through Bellot Strait was made on 6 September 1957 by the four vessels taking part in Operation Bellot—H.M.C.S. Labrador, *and the United States vessels* Storis, Bramble *and* Spar.

Strait to the Atlantic would provide a means of escape.

With this in mind, Canadian and United States authorities decided that the area between Shepherd Bay and Prince Regent Inlet should be examined during the 1957 season, if possible. Properly equipped vessels were to be in the vicinity in any case to complete work required for the DEW line and there would be no conflict between the two projects because the DEW line work would be finished by the end of August, which was the best time to undertake a survey in the Bellot Strait area. The latter project was officially named Operation Bellot and was to consist of two elements — H.M.C.S. *Labrador*, which was to approach the area from the east; and three United States Coast Guard vessels, *Storis*, *Bramble* and *Spar*, which were to approach from the west. Command of the operation was vested in Captain T. C. Pullen, R.C.N., Commanding Officer of the *Labrador*.

The *Labrador* was the first to complete her other commitments, and arrived on the scene on 18 August, when she reached the northern end of Prince Regent Inlet. Captain Pullen had surveyed the inlet the previous season, and knew that there was no problem of water depth, so he proceeded directly to Bellot Strait. Fog shrouded the entrance to the strait when the *Labrador* arrived on 20 August, but the next day dawned bright and clear, and Operation Bellot was under way. The *Labrador*'s first job was to establish a shore base for the hydrographers, who were to conduct detailed small-boat surveys, triangulation studies, and tidal measurements. The spot chosen was Fort Ross, the abandoned Hudson's Bay Company trading post on the southeast tip of Somerset Island. Although the buildings of the small post had not been occupied since 1947, the dry arctic climate had left them in excellent repair and with the permission of the Hudson's Bay Company, the party used the post manager's house

Captain T. C. Pullen, R.C.N., Commander of Operation Bellot, holds a conference on the bridge of H.M.C.S. Labrador *with the commanding officers of the other ships which took part in the project. From left to right: Commander H. L. Wood* (Storis), *Captain Pullen, Lieutenant C. V. Crewing* (Spar), *and Lieutenant Commander H. H. Carter* (Bramble).

as its headquarters. When Eskimos, who were hunting in the area, saw a ship anchored off Fort Ross, they assumed the post was being reopened for business and next morning were at the store with white fox furs to trade. Their disappointment was only partly assuaged by the gifts of food and tobacco they received from members of the *Labrador*'s crew.

On 22 August, the *Labrador*'s thirty-six-foot aluminium sounding boat, *Pogo*, made a rapid transit of Bellot Strait to locate any major hazards in the twenty-mile passage. The only problem they encountered was the current, which reaches a speed of eight knots when the tide is running full, and very nearly brought the light craft to grief. The following day, all work had to stop because the ice, which quickly comes and goes from the strait, had choked the passage. However, by the morning of 24 August it was clear again, and with all hands at special duty stations, the *Labrador* set off along the narrow waterway which marks the end of the North American mainland. At 10.20 a.m., the northernmost tip of the continent was passed, and three-quarters of an hour later, the *Labrador* was in Franklin Strait at the western end of Bellot Strait.

This was the first of a number of passages that the *Labrador* was to make through Bellot Strait during the next ten days. For a vessel of her size and power the current did not prove to be a serious problem and any ice which drifted into the strait was soon carried out again. The only important hazard was found five miles in from the eastern entrance. At that point a wide tongue of glacial rubble stretches almost three-quarters of the way across the passage from the coast of Somerset Island, and creates a shoal with a minimum depth of ten to fifteen feet. Just off the mainland at this point lies Magpie Rock, a sharp underwater pinnacle about two feet below the surface at low tide. The usable channel between these two obstacles is only about 1,000 feet wide and fifty feet deep. However, the area was surveyed in detail by the *Labrador*'s small boats, and with beacons now in place, it need not be a problem for navigators.

On 25 August, a second survey group was put ashore, this time at the western entrance to Bellot Strait and while the two parties were carrying out their detailed work, the *Labrador* was free to do some exploring. During the next few days, she circumnavigated Somerset Island and while off the southeast coast on 27 August, a party was landed at Fury Beach by helicopter. This was the point where, 132 years earlier, H.M.S. *Fury* was driven ashore by wind and ice. Before the ship was lost, her crew managed to get most of the supplies ashore and for years the spot was an emergency cache for other arctic explorers in the area. Even in 1957, relics

of the *Fury* could still be found and several small items were collected for the Maritime Museum in Halifax.

In the meantime, the ships of the western element of Operation Bellot — the *Storis*, the *Bramble* and the *Spar* — had begun work on their part of the project. The *Labrador* was specially built for arctic work but the smaller American vessels were not. Nevertheless, the sturdy little ships, of a type known as "buoy tenders", had proved their worth in previous seasons in the western Arctic, where numerous shoals place a premium on shallow draft. In comparison to the thirty-foot draft of the *Labrador*, the largest of the United States vessels, the *Storis*, draws fourteen feet, while the *Bramble* and the *Spar* have a twelve-foot draft.

The Coast Guard ships had set out from Seattle on 1st July, and ever since entering arctic waters had been conducting hydrographic survey work on the DEW supply routes, particularly in the treacherous Queen Maud Gulf and Simpson Strait areas. With their DEW line task completed, they gathered off the tiny settlement of Gjoa Haven on the last day of August to begin their part in Operation Bellot, which was to conduct a reconnaissance survey of the area between Shepherd Bay and the western entrance to Bellot Strait. A small Hudson's Bay Company ship annually makes its way up Rae Strait as far as Spence Bay to supply the trading post there, but north of that point the waters were almost unknown. Larsen had been the last explorer to sail through the area in 1941-42 and there were only two or three others before him.

Ice and feezing temperatures are the accepted hazards of arctic exploration but they were hardly a problem, as the United States ships prepared to set out on the morning of 1st September. The sun was shining, the temperature was fifty-three degrees Fahrenheit, and there was no ice to be seen anywhere. In fact, the weather was practically ideal throughout the ten days of Operation Bellot, and ice never caused serious difficulties. As the ships proceeded up the coast of Boothia, it was difficult to realize that just a week later in 1941, the weather and ice were so bad that Larsen was forced to halt his operations for the season and winter in nearby Pasley Bay.

From Matheson Point, on the southeast tip of King William Island, the Coast Guard ships sailed up Rae Strait in line abreast, their automatic equipment busily taking soundings every few seconds. Conditions were excellent in this area where the water reached a depth of 250 feet, but it was not long before more difficult going was encountered. At the head of Rae Strait, Matty Island forms a natural barrier between Boothia Peninsula and King William Island. The water is extremely shallow and because of wind and current conditions, the area is a natural collecting ground for ice drifting down from the north. At this stage the commanding officer of the group, Commander H. L. Wood, had a major decision to make — whether to go up the east side of Matty Island to James

The post manager's house at Fort Ross, the abandoned Hudson's Bay Company post on the south-east tip of Somerset Island, served as the headquarters for the shore party from H.M.C.S. Labrador.

Ross Strait, or along the west side through Wellington Sound. When Amundsen and Larsen faced the same problem, they chose the eastern side, and Commander Wood followed suit. The ships proceeded cautiously and no serious difficulties were encountered, although at one point a person leaning over the side of the *Storis* could see the bottom. The Matty Island area is one which will require more intensive study if the route is to be used to any extent. An air reconnaissance made from the *Storis*' helicopter at the time suggested that the Wellington Sound side might provide a better alternative.

The *Storis*, *Bramble* and *Spar* spent the night of 1st September anchored in the entrance to James Ross Strait, and the next day it was afternoon before survey work could be resumed because of a dense fog, which at one time limited visibility to about 100 yards. Later in the day the first real ice was encountered and by evening it had increased to six-tenths coverage. Progress was necessarily slow and the three vessels were less than fifty miles north of Matty Island at seven o'clock on the morning of 3 September when the *Labrador* appeared through the mist. With his small-boat parties still at work in Bellot Strait, Captain Pullen had decided to meet the United States ships and see if he could offer any assistance. The meeting took place seventeen miles northwest of Cape Victoria, just off a point on the coast of Boothia Peninsula, already famous in the annals of arctic exploration. It was here in 1831 that James Ross first located the North Magnetic Pole and raised a cairn to mark the spot. As it turned out, the *Labrador*'s arrival was most opportune, because the ice remained heavy and without her broad bow to clear a path, progress might have been difficult. Around noon, the heaviest ice of the entire operation was encountered — eight-tenths coverage of badly broken winter ice. However, with *Labrador* leading the way, the group was able to maintain a speed of more than six knots and by the end of the afternoon, they were through the worst of the ice.

The next morning, 4 September, was a memorable one, particularly for those on board the United States ships, for at 8 a.m. they caught their first sight of Bellot Strait, the goal they had been seeking for more than two months. With the rising sun streaming through it, the great notch in the Boothia coastline, which is Bellot Strait, was a dramatic sight. The next two days were spent in intensive hydrographic survey work off the western entrance of the strait to complete the scientific programme of Operation Bellot and then on the evening of 5 September a full-dress mess dinner was held on board the *Labrador* to celebrate the success of the project. The four ships anchored side by side in False Strait, a bay just north of the western entrance to Bellot Strait; black ties were the order of the day despite the bleak arctic surroundings; and the visiting United States officers were piped aboard in approved naval fashion. For the occasion the *Labrador*'s cooks had somehow prepared an excellent five-course meal, even though there had been no fresh food for almost three months.

The following day, Saturday, 6 September, was probably the climax of the project. Weighing anchor at 11 a.m., the four vessels set off through Bellot Strait with the *Labrador* leading the way. After some early morning fog, the day had turned bright and clear, the temperature was forty degrees and there was no ice as far as the eye could see. On both sides of the mile-

On a hill behind the abandoned Hudson's Bay Company post, Fort Ross, a member of the crew of H.M.C.S. Labrador *found a message left in September 1942 by Sergeant H. A. Larsen, when he sailed through Bellot Strait in the R.C.M.P. patrol vessel* St. Roch.

H.M.C.S. Labrador, *led by her survey boat,* Pogo, *sets out to make her first transit of Bellot Strait. In the foreground is Magpie Rock, an underwater pinnacle marked only by the ripples on the water's surface.*

wide passage, the sheer rock faces of the coastline rose directly from the water and the sparse vegetation was still green enough to provide an attractive contrast to the blues of the sea and the sky. At the half-way point, it was possible to see both Prince Regent Inlet to the east and Franklin Strait to the west. As Magpie Rock was passed, its presence was marked only by a slight ripple on the surface of the water and it was hard to realize that in 1942, when the passage had last been attempted, Larsen had come within a hair's breadth of losing the *St. Roch* at this very spot. It was also difficult to realize that although Bellot Strait was indeed a gateway between the eastern and western Arctic, more ships were passing through it on that particular September morning than on all other occasions combined.

Shortly after one p.m., the ships anchored off Fort Ross and the four captains went ashore. In the accepted tradition of arctic exploration, a record of their activities had been prepared and after being signed by each of the commanding officers, it was placed in a cairn on a hill behind Fort Ross. That was the last official act of Operation Bellot and during the evening the two elements separated. The *Labrador* spent another three weeks elsewhere in the Arctic before completing another outstanding season of northern work. The Coast Guard ships made their way directly to Boston, where they received a hearty "well done" for the impressive record they established. During the summer, they had become the first United States ships to sail the Northwest Passage, the first United States ships to circumnavigate North America, and the first ships of any country to make the passage from west to east in a single season.

The great mass of detailed information collected during Operation Bellot is still being processed, but before long it will be available on charts and tables for those who have occasion to sail through that part of the Arctic. How many of these occasions there will be remains to be seen, but the path has now been clearly marked and in the process the age-old search for the Northwest Passage has been brought to an end.

Transportation North of Sixty

by W. H. VAN ALLEN

THIRTY YEARS ago a white man and two Eskimos travelled by dog sleigh from the vicinity of Frobisher on Baffin Island to Point Barrow in Alaska. It took them three years to make the trip. Today the trip can be made in one day by air. This possibly demonstrates the advances in transportation in the Canadian north more forcibly than any statistics or chart.

It is likewise a far cry from the early exploration ship used by Franklin in his ill-fated Arctic expedition of 1845 to the modern ice-breakers of the Department of Transport, which plough through ice which would have made earlier sailing impossible. Improved transportation has made it possible for Canada to look northward. In addition to transportation by air and water, the movement of bulk commodities by rail and highway is now being facilitated to enable the development of natural resources in areas which were formerly referred to as "Barren Lands" and the "Frozen North".

It was on 1st September 1890 that the British Government granted to Canada all the territory in the northern waters of the "Continent of America and Arctic Ocean". This embraced the territory from 60° to 141° west longitude and as far north as 90°, that is to say, the North Pole. Today Canada's northland is an integral part of the trans-polar air route between North America and Europe, and the Department of Transport has converted the former air base at Frobisher into a civilian airport to service aircraft operating on this route.

Frobisher airport, located but 200 miles from the Arctic Circle, is the northernmost civil airport able to accommodate aircraft of the type now flying the North Atlantic route. With Pan-American World Airways using

At top:—The ice-breaker C. G. S. d'Iberville *ploughs through sixteen-foot ice in Eureka Sound, latitude 79° north, on her way to re-supply the sixteen-man Arctic weather station at Eureka, operated jointly by Canadian and United States weathermen. The pattern on the ice is caused by mid-summer melting of the ice surface.* N.F.B.

Super Constellations and DC-7 aircraft on their flights between San Francisco and Europe, and Canadian Pacific Airlines introducing the new Britannia on their Vancouver-Amsterdam run, only an airport of the dimensions of Frobisher could be used for re-fuelling stops.

It is not generally realized that in Canada there are nearly 120 airports, waterports and landing strips in that area of Canada lying north of the sixtieth parallel. Of these, one-third are located north of the Arctic Circle. These are used mainly for civil aviation purposes, although those in the vicinity of the DEW Line are of necessity on a security restriction basis. Thirty-six airbases on or about the sixtieth parallel are serviced by licensed air carriers. These are mostly government-owned and operated.

Water transport complements air transport in the northland. For instance, at Frobisher many thousand tons of supplies, equipment, construction material and fuel for aircraft are brought in by freighters and tankers during the three months of open navigation. A 725-foot causeway will be completed this summer to facilitate the unloading of ships. Many thousands of tons of supplies are also shipped every summer by convoy, escorted by ice-breakers, to Resolute on Cornwallis Island. Resolute is located about 1,100 miles from the North Pole and is the central storage and aerial distribution centre for the weather stations in the far north.

In the western Arctic, Sachs Harbour on Banks Island, Aklavik, Coppermine, and other outposts on the mainland are serviced by aircraft and by water transport. To more efficiently supply these and other outposts in the Western Arctic, the Department of Transport is having an ice-breaker constructed at a west coast shipyard. Other ice-breakers are being constructed in Eastern Canada to strengthen the Department of Transport's fleet for operations in the Eastern Arctic.

An interesting indication as to what the future holds for transportation in Canada's Arctic waters was the announcement recently by the Honourable George Hees, Minister of Transport, that "the Department is studying the use of nuclear power for ice-breaker propulsion, and we are setting up a committee to keep in touch with progress in other countries, with a view to application of nuclear power to Canadian ice-breakers, in the future. This committee will also keep in touch with progress which may be made by Canadian commercial companies interested in the construction of nuclear-powered ships, or propulsion equipment."

Indicative of development of the northland, traffic on the 1,600-mile Athabasca-Great Slave-Mackenzie waterway from Northern Alberta to the Arctic Ocean increased by nearly 300 per cent in the ten years prior to 1956. Traffic estimated for 1958 is 211,310 tons, an

Supplies for joint Canadian-United States weather stations are shipped north by water to the assembly point at Resolute, then are flown in by R.C.A.F. aircraft. Here supplies are being unloaded at the Isachesen airstrip.

Thousands of drums of liquid fuel to heat Arctic weather stations and operate diesel engines for light and power are shipped in by water to Resolute and thence by air to outlying stations.

increase of 24,000 tons in the past two years. The Department of Transport has established a District Marine Agency with headquarters at Fort Smith in the Northwest Territories to oversee its increasing duties in the Northwest Territories and Western Arctic. Since this was established in 1956, aids to navigation on this inland water route, mainly buoys and markers, have been greatly increased. Long daylight hours during the navigation season in these latitudes make it possible to practically do without lighted aids. In Hudson Strait and Hudson Bay aids to navigation are being improved by installing modern equipment with substantially greater light intensity.

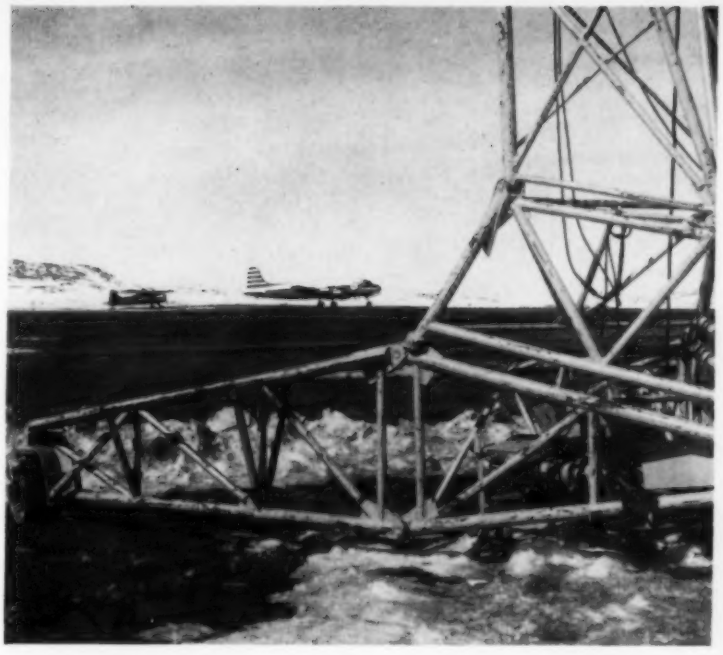
Land transportation facilities for moving bulk commodities like minerals and forest products are required to follow up earlier prospecting and preliminary development to bring Canada's new-found wealth to world markets. Several railway lines have been built during the past few years into the proven mineral areas. In addition, roads are being built into the northland either within the territories of the provinces or in the Yukon and Northwest Territories.

At present the Federal Government and Canadian National and Canadian Pacific railways are studying the possibility of construction of a railway line to Great Slave Lake to tap the very large mineral ore bodies now known to exist in that part of the Northwest Territories bordering on the Province of Alberta. Because of their joint interest in the existing Northern Alberta Railways, the two railways have been conducting studies to determine the best route, its probable cost and the volume of traffic it might generate.

Work has already been started by the Department of Northern Affairs and National Resources on major road construction projects in the Yukon and Northwest Territories, involving over 1,200 miles of roads and six major bridges at an estimated cost of over $31,000,000. In the Yukon, plans call for the construction of a development road from the existing Yukon road system at Flat Creek, about twenty-five miles southeast of Dawson, running northeast some 170 miles to the southern edge of the Eagle Plain, where large-scale exploration for oil is now going on. This section of the road is to be completed in 1960. The road will fork from Eagle Plain: one branch running northwest seventy miles into the drilling area, the other running northeast some 160 miles to Fort McPherson. Construction of these additional sections of the road is expected by 1962.

Included in the Yukon plan is the construction of bridges where the Keno-Whitehorse highway crosses the Pelly, Yukon and Stewart Rivers, to replace summer ferries and winter ice bridges and open this important ore-hauling road to year-round traffic. At present freeze-up and break-up on the rivers interrupt traffic for about three months each year. In addition, a

Right:—Although high-powered aircraft fly over the north country and specially adapted motor vehicles traverse its surface, the dog team is far from obsolete. A team in northern Manitoba.
Hudson's Bay Company.



Owing to its strategic position on the trans-polar air route, Frobisher airport has developed overnight to world importance.

new road is to be built from Dawson to the recently discovered base metals and asbestos deposits at Clinton Creek.

In the Northwest Territories, the major road project is the 550-mile Great Slave-Great Bear road to provide all-year communication with Yellowknife and to assist exploration and development in the richly mineralized areas lying between Great Slave and Great Bear Lakes. Construction work on the first stage, 300 miles around the west end of Great Slave Lake to join Yellowknife with the Mackenzie Highway, will be completed in 1960. In addition, bridges will be built over the Kakisa River and the northwest arm of Great Slave Lake, and either a bridge or a ferry will be provided to cross the Mackenzie River.

In the second stage, the road will go on another 250 miles to Great Bear Lake. From Marian Lake near Fort Rae a road which now runs some thirty miles north to serve local mining developments will become part of the development road system. Farther north it will follow the boundary of the Precambrian Shield to Sawmill Bay on Great Bear Lake, where an airstrip already exists.

Other road developments in the Northwest Territories will provide for the hard surfacing of the Fitzgerald-Bell Rock Portage Road on the Slave River transportation route, where water-borne freight, transported in and out of the Northwest Territories along the Mackenzie River system, must be trucked over a twenty-four-mile portage to by-pass rapids on the Slave River at the Alberta boundary. A new seventy-eight-mile road will be constructed from Peace Point to the west boundary of Wood Buffalo National Park. This will assist in developing the timber resources of the area and, when the Province of Alberta constructs a road from North Vermilion, will provide the first year-round overland communication between Fort Smith and outside points.

Mention was made in the opening paragraph of transportation by dog team. No matter how much transportation is developed in the north, the dog sleigh will never become obsolete. The Eskimos, the Royal Canadian Mounted Police, explorers and scientists, trappers and prospectors still use them and will continue to do so. At Frobisher, there are many good dog teams kept in readiness for winter operations, and residents enjoy Sunday jaunts by dog team during the winter months. There is, too, the possibility that sleigh rides will become an attraction for tourists whose aircraft are held over by inclement weather or for minor mechanical adjustment.

Above:—Consisting only of an operation building (right) with living quarters for the eight-man crew, a power house and a hydrogen building for inflating weather balloons, the lonely meteorological outpost at Sachs Harbour on Bank's Island issues weather reports which are essential to safe flying in North America.

Highway projects in Canada's northwest.

Below:—One of the animals peculiar to the far north is the musk ox. This group was seen across Slidre Fiord from Eureka on Ellesmere Island.

JOURNAL ARTICLES ON THE CANADIAN NORTH

For the convenience of those interested in more extensive information on the Arctic and Subarctic, we provide a list of some of the articles published in the Journal on this subject during the past:

Arctic Wild Flowers by A. E. Porsild.....May 1930
With the Arctic Patrol by Dr. F. G. Banting.....May 1930
Adventuring in Baffin Island by J. Dewey Soper.....July 1930
The Franklin Search by L. T. Burwash.....Nov. 1930
Searching the Arctic by Aeroplane by G. H. Blanchet..Dec. 1930

On the Rat River, Northwest Territories by C. C. Rogers.....Jan. 1931
The Gravel River Indians by Frank Ebbutt.....April 1931
In Polar Lands by Sir Hubert Wilkins.....June 1931
Port Churchill by D. G. Ridout.....Aug. 1931

Flying Along the Mackenzie by T. Wayling.....May 1932

The Yukon and Her Flowers by Mrs. G. Black.....Jan. 1933
An Arctic Sled Journey by Richard Finnie.....Feb. 1933
"Down North" to Great Bear Lake by Allen Bill....May 1933
Solitudes of the Arctic (Baffin Land) by J. Dewey Soper.....Sept. 1933

Eight Hundred Miles on the Yukon by W. K. Gibb..March 1934
Old Trails to the Arctic by P. H. Godsell.....April 1934
In the Land of the Musk-Ox by G. H. Blanchet.....June 1934

The Mounties in the Arctic by Maj.-Gen. J. H. MacBrien.....April 1935
Canada's Northernmost Island (Ellesmere Is.) by W. Eggleston.....June 1935

Mapping Canada by F. H. Peters.....Jan. 1936
Vagabonding in the Arctic by T. H. Inkster.....Feb. 1936
Flying Through Northwest Canada by Charles Camsell.....March 1936
South Nahanni River, Northwest Territories, by Alan E. Cameron.....May 1936
Feathered Pioneers of the Canadian Northwest by Hamilton M. Laing.....May 1936
The Copper Eskimos of Coronation Gulf by C. H. Dodwell.....June 1936
Modern Pioneering in Canada's Western Sub-Arctic by R. Finnie.....Sept. 1936
An Eleven Thousand Mile Inspection Trip by Sir J. MacBrien.....Nov. 1936

Eskimo Exodus by T. Wayling.....Jan. 1937
Great Bear Lake—An Exploration and its Sequel by Charles Camsell.....March 1937
North to the Yukon by Air by J. Fergus Grant.....Aug. 1937
Exploring Upper Nahanni River and Snyder Mountain by Harry Snyder.....Oct. 1937

The Golden North, Labrador and North Shore by Leo Cox.....April 1938
The Annual Eastern Arctic Patrol by D. L. McKeand..July 1938
Spectacular Frobisher Bay by Martin J. Buerger.....July 1938
Conquest of Mount Lucania by Bradford Washburn...Oct. 1938

The Yellowknife Mining District by Charles Camsell..June 1939
New Wings for the Yukon Mail by J. Harper Prowse..Dec. 1939

Canada's Eastern Arctic Patrol by R. S. Marriott....March 1940
My Home Town—Fort Liard by Charles Camsell....Sept. 1940
A Road to Alaska by L. J. Burpee.....Nov. 1940

Canada Moves North by Richard Finnie.....Nov. 1941

Southampton Island by T. H. Manning.....Jan. 1942

The Coastal District of the Eastern Barren Grounds and Melville Peninsula by T. H. Manning.....Feb. 1943
Northwest Passage by Air by J. A. Wilson.....March 1943
Canada's Northern Air Routes by D. B. Wallace....Oct. 1943
The "Canol" Project by O. B. Hopkins.....Nov. 1943
Planning the New Northwest by Charles Camsell....Dec. 1943

Alaska Highway by S. C. Ells.....March 1944
Agricultural Lands in the Canadian Northwest by E. S. Archibald.....July 1944
Mineral Resources and Mining Activity in the Canadian Eastern Arctic by J. L. Robinson.....Aug. 1944
Eskimo Population in the Canadian Eastern Arctic by J. L. Robinson.....Sept. 1944
Economic Wild Life of Canada's Eastern Arctic (Caribou) by J. G. Wright.....Oct. 1944

Fur Rehabilitation in Northern Manitoba by D. M. Stephens.....Jan. 1945
Conquest of the Northwest Passage by R.C.M.P. Schooner St. Roch by J. L. Robinson.....Feb. 1945
A Brief History of Exploration and Research in the Canadian Eastern Arctic by P. D. Baird and J. L. Robinson.....March 1945
Land Use Possibilities in Mackenzie District, N.W.T. by J. L. Robinson.....July 1945
Agriculture and Forests of the Yukon Territory by J. L. Robinson.....Aug. 1945
Plant Life of the Churchill District by Eva Beckett..Aug. 1945

Water Transportation in the Canadian Northwest by J. L. Robinson.....Nov. 1945

Fur Production in the Northwest Territories by M. J. and J. L. Robinson.....Jan. 1946
Winter Manoeuvres in Canada by J. T. Wilson.....Feb. 1946
Weather and Climate of the Northwest Territories by J. L. Robinson.....March 1946
Exploration and Settlement of Mackenzie District by M. J. and J. L. Robinson.....June and July 1946
The New North by Charles Camsell.....Dec. 1946

Epic of Canol by Richard Finnie.....March 1947
North on the Hudson Bay Railway by Lyn Harrington.....Aug. 1947

Old Crow's Village (Yukon) by Douglas Leechman...July 1948
Mistassini Territory of Northern Quebec by J. M. Neilson.....Oct. 1948
Surveying on the Hamilton River, Labrador, by G. H. Desbarats.....Nov. 1948
Canada's Western Arctic by J. L. Robinson.....Dec. 1948

Tractor Trails in Manitoba by Lyn Harrington.....Feb. 1949
Churchill, Manitoba, by M. Y. Williams.....Sept. 1949
Recent Developments in the Canadian North by H. L. Keenleyside.....Oct. 1949

Churchill, A Naturalists' Rendezvous by M. Y. Williams.....Feb. 1950
Yukon Territory by D. Leechman.....June 1950
Journey in Arctic Quebec by R. Harrington.....Aug. 1950
Is Canada's Northwest Subhumid? by M. Sanderson.Sept. 1950
Expansion of Aviation into Arctic and Subarctic Canada by J. A. Wilson.....Sept. 1950
Coppermine Patrol by R. Harrington.....Dec. 1950

Education Goes North by E. N. Grantham.....Jan. 1951
Baffin Expedition 1950 by P. D. Baird.....May 1951
The Alaska Highway by L. Harrington.....June 1951
St. Elias Mountains by N. E. Odell.....July 1951
Mapping the North by D. F. Coates.....Aug. 1951
The Dawson Route by L. Harrington.....Sept. 1951
Wild Wings over the Tundra by E. Beckett.....Oct. 1951
Some Eskimos of Chesterfield Inlet by J. Michea....Nov. 1951

The Padleimiuts by R. Harrington.....Jan. 1952
The Pas, Crossroads of the New North by M. E. and A. C. Robinson.....Aug. 1952

Map Changes by Glaciers by I. G. Temple.....March 1953
Spring Break-up at Boothia by R. Harrington.....April 1953
Puppets of the Skeena by Josephine H. Dunn.....Dec. 1953

The Cumberland Peninsula of Baffin Land by P. D. Baird.....March 1954
Yellowknife: Town of the Air Age by A. Leitch.....May 1954
Land Use in the Arctic by A. E. Porsild.....June-July 1954
The Stikine River by L. Harrington.....Aug. 1954
Eskimo Sculpture in Stone by D. Leechman.....Sept. 1954
By North Star to the North Pole by L. W. Brockington.....Nov. 1954

Wilderness Our Neglected Treasure by H. F. Lewis..Jan. 1955
Summer School North of Sixty by I. Baird.....Jan. 1955
Aklavik—A Problem and Its Solution by R. G. Robertson.....June 1955
Aksunai by E. C. Miller.....July 1955

Wilderness Run to Ben-my-Chree by A. Leitch.....May 1956
Our Polar Islands—the Queen Elizabeths by A. Taylor.....June 1956
Mackenzie Highway Leads Down North by L. and R. Harrington.....Aug. 1956
Peace River's Second-Righters by F. Inglis.....Sept. 1956
The Development of Transportation in the Canadian North by C. H. Herbert.....Nov. 1956

The Eastern Arctic Patrol by R. A. J. Phillips.....May 1957
Knob Lake on Canada's New Frontier by W. G. Ross.June 1957
Moosonee and Moose Factory by F. Bruemmer.....July 1957
Shoran Reconnaissance in Canada's North by F. C. Hoefsmit.....Aug. 1957
The Soviet North and the Canadian North by O. Fisher.....Sept. 1957
Anoutoaloak: Mace of the Northwest Territories by I. Baird.....Sept. 1957

Ungava Bay—Ungava Peninsula by Robert Bergeron..July 1958
The Face of the North by N. L. Nicholson.....Sept. 1958
The Romance of Northern Exploration by F. J. Alcock.....Sept. 1958
Old and New Ways in Arctic Geology by Y. O. Fortier.....Sept. 1958
Archaeology in the Canadian Arctic by Wm. E. Taylor Jr.....Sept. 1958
Fish in the Canadian North by H. D. Fisher.....Sept. 1958
Agricultural Research in Sub-Arctic and Arctic Canada by F. S. Nowosad.....Sept. 1958
Operation Bellot by C. J. Marshall.....Sept. 1958
Transportation North of Sixty by W. H. Van Allen...Sept. 1958

OBITUARY

Oliver Master 1891-1958

It is with profoundest regret and a feeling of deep personal loss that we have to record the death of Mr. Oliver Master of the Department of Trade and Commerce which occurred on 6 August at Grimsby, Ontario. In him, the Royal Canadian Geographical Society has lost one of its best friends and advisers, one who has watched over and helped direct the policy of the society ever since its first inception. He was a charter member of our society and served on our Editorial Committee, first as a member and later as chairman. His wide knowledge, experience and tact was ever at the service of the Editor and the Editorial Committee in helping to guide editorial policy. Through fair weather and foul, he was a good friend and a steady pilot for nearly thirty years.

Oliver Master was born at Grand Valley, Ontario, and was educated at Plattsville, Kitchener and Queen's University, Kingston, where he took his degree in 1914. On the outbreak of the First World War he went overseas with the thirty-eighth battalion of the Canadian Expeditionary Force, and served as a machine-gunner. On his return to Canada he was appointed Assistant Secretary, and later Secretary to the Commission of Conservation at Ottawa. In 1921 he became economic adviser to the Department of the Interior, and eleven years later he was appointed Secretary of the Main Committee on Economic Co-operation at the Empire Economic Conference held in 1932 at Ottawa. After this he became Chief in the Economics Division of the Commercial Service. He also served as secretary between 1938 and 1945 on each of the three Royal Commissions appointed to adjudicate the claims made by the provinces of Manitoba, Saskatchewan and Alberta arising out of the transfer of their resources from federal administration to provincial control.

In 1940 he was appointed Assistant Deputy Minister of Trade and Commerce, and between 1942 and 1945 he was Acting Deputy Minister. As such he bore his full share of war-time burdens, and worked on the Foreign Exchange Control Board; he was Chairman of the Shipping Priorities Committee, and a member of the Advisory Committee on Economic Policy, also of the Merchant Shipping Policy Committee. All these varied activities gave him a range of experience which made him a most valued adviser and contributor to this Journal, and his loss is irreplaceable.

We respectfully tender our deepest sympathy to his widow, Mrs. Sarah Master, and to his daughter, Mrs. John Keenan.

* * *

EDITOR'S NOTE-BOOK

Dr. N. L. Nicholson (*The Face of the North*) is Director of the Geographical Branch, Department of Mines and Technical Surveys, Ottawa. He joined that department in 1949 after lecturing in geography for three years at the University of Western Ontario. Previously he had been meteorologist with the British Air Ministry. During the Second World War he served with the Royal Air Force. He is the author of a book, and many articles and book reviews printed in North American and British publications.

* * *

Dr. F. J. Alcock (*The Romance of Northern Exploration*) was Chief Curator of the National Museum of Canada from 1947 until his retirement in 1956. For many years Dr. Alcock was a member of the staff of the Geological Survey of Canada. His chief activities were in connection with the Precambrian fields of Western Canada, the Appalachian and Acadian region of Eastern Canada, and the zinc and lead deposits of Canada. He has published numerous geographical and geological reports and articles.

* * *

Professor H. W. Jannasch (*Reunion With Mikak*), a descendant of Moravian missionaries, was born at Nain, Labrador, and educated in Germany. He became a teacher and social worker in Germany. At the time of his retirement a few years ago he was professor in the teachers' college in the famous university town of Gottingen. His maternal grandfather, J. A. Miertsching, accompanied Sir Robert M'Clure on his famous voyage of 1850-54 into Canada's Arctic waters as the expedition's authority on Eskimo languages.

Dr. Y. O. Fortier (*Old and N... Ways in Arctic Geology*) has se...ved Chief of the Precambrian Division the Geological Survey, Depart... of Mines and Technical Surve... Ottawa, since the spring of 19... Previously he conducted geologi... investigations in the Arctic islan... After obtaining his Bachelor of Scie... degree at Queens' University, he w... on to McGill for his Master's deg... and to Stanford for his doctorate.

* * *

Dr. William E. Taylor Jr. (*Archa... ology in the Canadian Arctic*) this su... mer spent his eighth season in t... Canadian Eastern Arctic as Arc... Archaeologist for the National M... seum of Canada. He has also d... archaeological field work in Ontar... Arizona, Illinois and Michigan. ... obtained his Bachelor of Arts deg... in anthropology at the University ... Toronto and his Master's degree ... sociology from the University ... Illinois, and completed his docto... courses at the University of Michig...

* * *

Dr. H. D. Fisher (*Fish in the Ca... dian North*) is scientist in charge ... the Arctic Unit of the Fisheries R... search Board of Canada. Dr. Fish... has been with the Board since 19... when he joined its Biological Stati... at St. Andrews, New Brunswick, ... do research in marine mammals. P... viously he was with the Wildli... Service of Canada. His present wo... entails investigation of the fisheri... of the Arctic seas and marine ma... mals and marine life in the Arctic.

* * *

F. S. Nowosad (*Agricultural R... search in Sub-Arctic and Arctic Ca... ada*) is officer in charge of Northe... Agriculture at the Central Expe... mental Farm in Ottawa. Prior to r... ceiving his present appointment, h... was engaged in research for t... Forage Crops Division of the feder... Department of Agriculture.

* * *

C. J. Marshall (*Operation Bell...* during the summer of 1956 acted ... Canadian Government observer wit... the United States ships that took pa...

"Operation Bellot", a project undertaken jointly by the Canadian and United States Governments to determine if there was a navigable channel between Simpson Strait and Prince Regent Inlet in the Canadian Arctic. This was the final chapter in the long arduous search for a Northwest Passage that preoccupied so many explorers in centuries past. Mr. Marshall is with the Department of Northern Affairs and National Resources.

* * *

W. H. Van Allen (*Transportation North of Sixty*) has served since 1940 as Chief of the Information Services for the federal Department of Transport. After obtaining his education in France and England, Mr. Van Allen was for a time on the staffs of Canadian Press and Reuters News Agency. In 1928 he entered public service, joining the publicity section of the Department of Trade and Commerce.

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AMONGST THE NEW BOOKS

Mission Completed

by Sir Basil Embry, G. C. B.
(Ryerson Press, Toronto. $5.00)

Mission Completed, written by Air Chief Marshal Sir Basil Embry, G.C.B., K.B.E., D.S.O. (three bars), D.F.C., A.F.C., is an outstanding account of development of aviation during more than a third of a century and the effect that it has had on military tactics. In straightforward language, Sir Basil recounts how aviation has changed the line of thinking of tacticians from World War I to the present day in which the air forces of the different nations are playing an all-important role in the set-up of the North Atlantic Treaty Organization.

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As former Commander in Chief, Allied Air Forces Central Europe, Sir Basil Embry speaks with experience when he writes: "The combined effect of nuclear weapons, the revolutionary advances in the delivery systems, and the possibility of surprise attack make it of paramount importance that our N.A.T.O. air forces should be at the height of efficiency and ready for instant action." Furthermore, he urges the need for "the handling of air forces by airmen who have made the study of three-dimensional war their life profession."

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W. H. VAN ALLEN

Mr. W. H. van Allen is chief of the Information and Editorial Bureau in the Department of Transport at Ottawa.

* * *

The Proterozoic In Canada
The Royal Society of Canada Special Publications, No. 2
Edited by James E. Gill
(University of Toronto Press, $5.95)

The volume consists of a preface by the editor and twenty-five papers prepared by twenty-three authors in connection with a symposium on the subject held by Section IV of the Royal Society at the annual meeting of the society in Montreal, June, 1956.

The volume brings together in summarized form the more recent ideas about what is meant by the term Proterozoic and what rock groups should be regarded as of that age. The name is applied to the younger of the two eras into which Precambrian time is commonly divided, the older era being referred to by Canadian geologists as the Archean (Early Precambrian). The following are the first

(Continued on page XII)

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For reprints of this painting, suitable for framing, write The House of Seagram, 1430 Peel St., Montreal, P.Q.

(Continued from page XI)

four papers: (a) Proterozoic in Canada, by J. M. Harrison and K. E. Eade, (b) Discussion of "Proterozoic in Canada" by J. T. Wilson, (c) Life in the Proterozoic by Alice E. Wilson and (d) Dating the Proterozoic of Canada by R. M. Farquhar and R. D. Russell, which summarizes the information on absolute ages determined from the decay of naturally existing radioactive isotopes. Then follow seventeen papers on various regions of the Canadian Shield where such rocks occur, prepared by authors who have had first-hand experience in the respective fields and who outline their ideas regarding the age of these rocks and their age relations to other rock groups. A series of three papers next deal with Proterozoic rocks outside the Shield. They are (a) The Proterozoic of Eastern Canadian Appalachia by L. J. Weeks, (b) The Proterozoic of the Cordillera in Southeastern British Columbia and Southwestern Alberta by J. E. Reesor, and (c) Possible Proterozoic Occurrences in British Columbia, the Yukon and Northwest Territories by H. C. Gunning. The final paper is a Summary and Discussion prepared by the editor. The papers are condensed, are for the most part supplied with a list of valuable references, and some are illustrated with maps, diagrams, succession tables, and so on.

For anyone who desires to keep abreast of the information accumulating about the Precambrian rocks of Canada the volume is most highly recommended. For the teacher or research student in geology it is a most stimulating summary, emphasizing the vast amount of work which still remains to be done before we can claim to have a satisfactory history of the various events of Precambrian time over the Shield as a whole, or any particular part of it. F. J. ALCOCK

Dr. F. J. Alcock was formerly Chief Curator of the National Museum of Canada and is lecturer on geology at Carleton University.

* * *

On the Old Lines

by Peter Allen

(Burns and MacEachern, Toronto. $5.50)

This is a valuable book depicting a trip around the world without the usual tedious details and explanations included in most travel jaunts. In showing uncommon glimpses of forty different countries, the author uses the steam locomotives which he found and photographed as his medium. In support of his choice, he ad-

(Continued on page XIV)

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You can hardly make a move where *money saving* or *money spending* is concerned, without at least remotely giving a nudge somewhere to a negotiable security. This applies whether you smoke a cigarette, buy a newspaper, ride on a train or turn on the gas. It applies whether you build an insurance estate or retire on a pension plan.

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(Continued from page XII)

heres to the dictum that "the steam locomotive is the most human, most appealing and most alive of all the machines yet made by man."

Although Allen shows a working knowledge of the rail-fan's jargon in his descriptions of the various rarities portrayed, much value rests in where these were located. He states, "There is a very considerable railway literature for the enthusiast (but) it inevitably deals with giant expresses and modern equipment and seldom describes the elderly, the recondite or the humble aspects of railroading."

The photographs, having been taken by the author himself as he journeyed into out-of-the-way places as a Director of the Imperial Chemical Industries, are adequately explained on the opposite pages with pungent remarks on the topography, social conditions and climate of the various lands where the observations were made. It is a pleasant way to learn many items of history and geography in an integrated form, particularly of the countries bordering on the Mediterranean and South America. It is also an opportunity to become acquainted with what has been man's "best friend" for over a century — the steam locomotive — before it is too late.

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